POWER

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Use a Tickler

WHAT an annual aggregate loss in life, time and money; what a burden of annoyance, embarrassment and unhappiness is caused by forgetfulness.

The engineer forgets that some element of the plant is due for inspection and overhauling, and a shutdown with its confusion and loss of credit and profit results.

The manager forgets that the engineer has reported a dangerous condition, and some mishap that might have been avoided occurs with more or less serious consequences.

The boss forgets an appointment or an opportunity, and the mill loses an order with resulting loss of income and reduction of employment for the working force.

We used to carry a notebook or a pocket pad, write upon it the things that we wanted to remember and then forget to look at it.

Modern living is so complex, the day's work comprises such a variety of ever-changing items, that it is difficult to carry on without some kind of a monitor and unsafe to depend upon an unreminded memory.

Nowadays we have the desk calendar from which the morning's first duty is to take a day off and see what the underlying sheet contains in the way of appointments, reminders and suggestions.

And this, properly kept up, will improve one's efficiency a great deal and save one a lot of trouble, especially if it is intelligently handled with respect to sufficiently advanced notice. It is discomforting to tear off yesterday's sheet and find that you should be leaving today on an important trip.

And this kind of a reminder, unlike the pocket pad, will not allow itself to be overlooked.

But even for the man without a secretary and who must handle it himself, a regular tickler file that disgorges every morning reminders of the things to which attention should be turned on that day is the best kind of a trouble saver. The memos of regularly recurring things can be returned to their jackets and the tickler becomes an annual order of business for routine affairs, with plenty of flexibility for the premonition and attendant details of special cases.

But it is not well to become too dependent upon such aids to the memory. There are things that ought to be a part of a man's regular thinking. The habit of recapitulation, of being alive to what he ought to be doing, conscious whether he is neglecting anything, will save him much of the discomfiture that goes with the admission "I forgot it."

F. R. Low

POWER *Stands for . . .*

1. **Making Power When It Should Be Made**
2. **Buying Power When It Should Be Bought**
3. **Cheaper Power Through Modern Equipment**
4. **Easier Financing of Equipment Purchases**
5. **Better Use of Byproduct Heat and Power**
6. **Operating Methods That Save Money**
7. **Less Waste in Transmission and Application**
8. **Prevention of Smoke, Within Reason**

Machine Tools and Power In the Colleges

TODAY every progressive industry bears the imprint of the technical school. Engineering graduates, once merely tolerated, have proved their worth as a body; they are eagerly sought as potential designers, operators and managers. Teachers of engineering, likewise, are frequently called in as consultants, with mutual profit to industry and education. Thus the technical schools have become builders of men to lead industry and molders of industrial thought.

As a consequence liberal support of these institutions by industry ceases to be philanthropical and becomes a plain matter of self-preservation. Some branches of industry see this, and stand solidly behind the work of the colleges; others are apathetic. Both extremes were recently encountered by a leading technical school engaged in the task of equipping one of America's greatest laboratories of mechanical engineering.

Builders of power equipment were approached first and responded splendidly. Engines, compressors, pumps and similar equipment was offered at shop—and in some instances as outright gifts. Many of these machines are now installed—and working for the manufacturers as truly as for the students. What graduate does not carry through life a vivid picture of the machines upon which he cut his engineering eye teeth?

In the very same building is an empty room with the label "Machine-Tool Laboratory" on the door—a fitting monument to a blind spot in the otherwise clear vision of a great industry. The machine-tool builders had exactly the same opportunity as the makers of power equipment, but the response bore no similarity. All offered to furnish their machines "at the standard price." Not a penny off for the privilege of representation in a perpetual machine-tool exhibit for future purchasers! Not a penny to make possible research work that will be a vital factor in future competition with Germany and other nations!

Builders of power equipment are to be congratulated on having a sense of values that includes the future as well as the present.

The Hams Hall Station

THE NEW Hams Hall generating station at Birmingham, England, is of interest to American readers, not because of unusual or spectacular features, but because of certain departures from American practice to meet local conditions. In the use of pulverized coal, hydraulic sluicing of ashes, preheated air, the regenerative cycle, water walls and many other features standard practice has been followed. The departures are principally in the size of units, the employment of cooling towers, sewage effluent for condensing purposes and in the plant site.

As part of the Central England Electricity Scheme the new plant is one of several projected to form the nucleus of a transmission network that will replace many small and unrelated stations. Moreover, it is the first central station in England built to use pulverized coal exclusively. The mills are small, to be sure, as are also the turbine units, judged by American practice, but their size is suited to the probable load conditions.

Instead of locating the plant where an adequate supply of condensing water would be available, with consequent longer haul for fuel and a greater transmission distance, as is common in this country, a site was chosen nearer the coal mines and near the center of electrical distribution. This involved the use of cooling towers, employing sewage effluent for condensing—a practice common in England. These cooling towers, which are of concrete, are the largest in that country.

The foregoing and other points mentioned in the description, elsewhere in this number of *Power,* must be taken into consideration when making comparisons between English and American practice.

Proposed Revision to A.S.H.V.E. Boiler Rating Code

AT ITS annual meeting last year the A.S.H.V.E. tentatively adopted a code for rating steam-heating boilers, which provided that tests be run according to the boiler test code and that curves of flue gas temperature and combustion rate be plotted from the test data. The intersection of these test curves with somewhat arbitrarily chosen limit curves of temperature and combustion rate determines maximum boiler rating.

At the recent meeting of the society in Philadelphia the code committee proposed a revision which in effect will eliminate the arbitrary limit curves and merely provide that manufacturers publish performance data for at least five outputs. For each output the revision requires that values be given for "fuel available," combustion rate, efficiency, flue gas temperature, draft and chimney dimensions. Such information will permit one to choose a boiler to meet the particular requirements.

This is a step in the right direction and it accords with the trend of power engineering practice. However,

the heating business is peculiar in that boilers are often specified by those not accustomed to interpret performance data. It is this element in the heating field that makes a rating code necessary.

The proposed revision offers a one-number rating for these persons by stipulating that one of the output ratings listed shall be equal to the maximum output of the boiler divided by the heating-up factor given in the A.S.H.V.E. code of minimum requirements. A boiler selected on this basis will be required to produce its maximum test output during each starting-up period. Since test results can seldom be duplicated in everyday operation, it is probable that the time required for heating up will be increased with time.

Members of the society will soon be called upon to vote on the proposed revision by letter ballot. The desirable features of the code are believed to overbalance the shortcomings of the one-number rating section, which can easily be remedied by including a safety margin in the heating-up factor.

Sulphurous Gases Undeservedly Accused

AN EDITORIAL appearing in the February issue of *Industrial and Engineering Chemistry* comments alarmingly upon some concrete building foundation piles which, it is stated, "have become disintegrated and reduced to the consistency of mush."

It proceeds then to philosophize upon the cause, and among other possibilities presents a theory that sulphate, formed in the combustion of coal burned in steam power houses, finds its way to the concrete foundations by deposition and subsequent percolation.

Power does not presume to comment upon the mixing of concrete or the manner of its placement, agglomeration or disintegration. That is for the concrete experts. The effect on concrete building foundations from the burning of coal for power generation is another matter.

The decomposition of exposed stone work and statuary from corrosive atmospheric conditions, while serious enough to warrant the attention it is receiving, is not of catastrophic consequence.

On the other hand, the implied destruction of near-by building foundations as the price of power from coal-burning power houses is too tragic to accept without comment. Let it be understood, despite the inference that "it is merely a matter of arithmetic," there is no basis of fact upon which to establish any relation whatever between disintegration of concrete foundations and sulphur content in combustion gases.

It is unusual that a statement of this character should appear in an engineering journal, since the perils from creating unnecessary apprehension among non-technical readers are well known. Already one New York daily newspaper has given scare-head space to the article. How many more will follow is difficult to estimate.

Loose statements on technical subjects which may mislead the lay mind are deplorable.

Metallurgy and the Diesel Engine

THAT THE United States Government was able, recently, to find an American manufacturer in position to build a thousand-horsepower aircraft Diesel engine is due to the assistance of the metallurgist. While some of the metallurgical innovations pertain solely to aircraft engines, others are applicable to the heavier, slower speed stationary engines, and have already been used in some instances. Diesel builders, on the other hand, have not been as prompt to adopt new materials as might be desired.

Early in the development of the oil engine, Dr. Diesel found that with the use of existing metals an extremely weighty design was necessary. This fetish of ponderosity has persisted in spite of metallurgical advances, and the Diesel is thereby barred from applications where it otherwise would prove advantageous.

Designers now recognize these weight and space defects and have countered with a steady increase in rotative and piston speeds. Only in a few instances have engineers adopted light alloys for the reciprocating parts. Aluminum and its alloys have been developed to a point where they may safely be used for pistons and connecting rods, and there is no reason why a heavy-duty engine should not be operated at five hundred rather than two hundred revolutions per minute. Aluminum, having a higher thermal conductivity than cast iron, permits the heat absorbed by the piston crown to be transferred to the jacket water without overheating of the crown. It follows that water cooling of nominal-sized pistons need not be resorted to. This will avoid a troublesome detail of engine design.

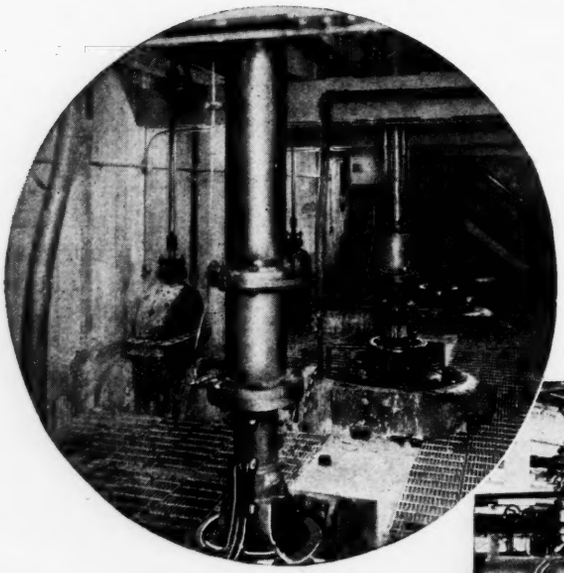
Similarly, chromium offers advantages as plating for the cylinder liners. Present-day cast-iron liners suffer from heat stress brought about largely by necessary thickness to withstand gas pressure. True, a cast-steel liner could be thinner, but cast-iron rings suffer by contact with a steel liner. If both the rings and liner were ground and then chromium plated, the rings would ride on the oil film with no preceptible wear. The liner itself could be a thin high-tensile steel forging, which would at once eliminate liner fracture and reduce initial and replacement costs.

The aircraft engine referred to will have aluminum cylinder heads, which leads one to wonder why such parts are not used on heavy-duty engines. Certainly the better heat conductivity should reduce head fractures.

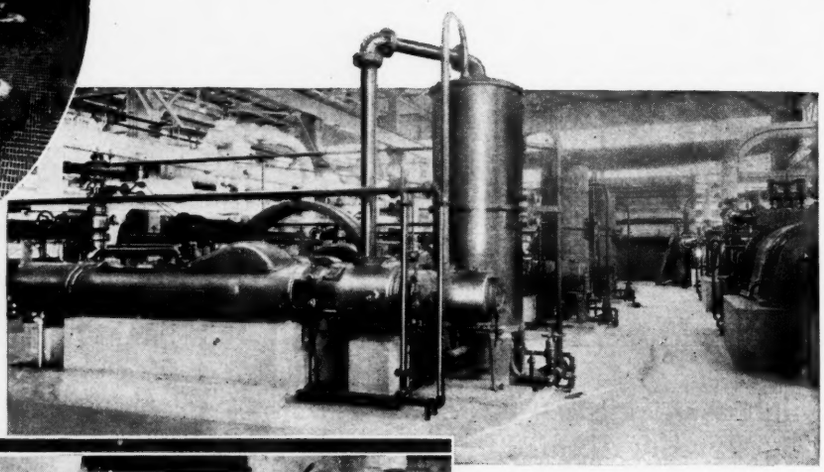
The nitro alloy that will be used for fuel-pump plungers and other parts offers equal advantages if applied to other Diesels. It is possible to find many small parts that must be made to close tolerances and are subject to wear.

Most of the available alloys offer the opportunity of decreasing weights and increasing speeds. Higher speeds mean ultimate lower costs of power plants, and should be the goal of engine designers. In this movement, operating engineers can be influential if they will discard the belief that slow speed means long reliable life, and permit, even encourage, light-weight high-speed engines.

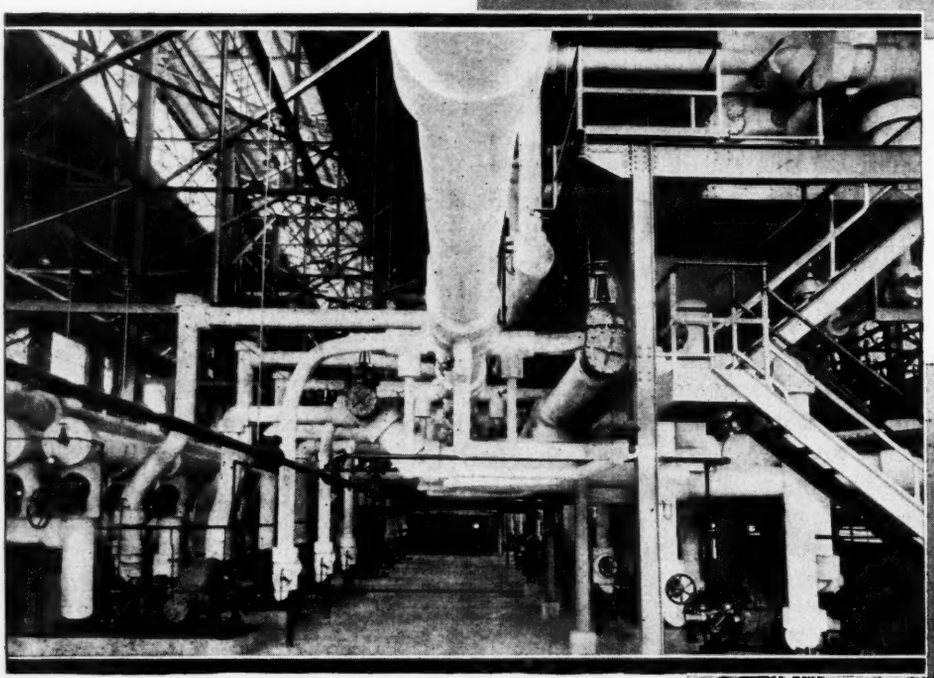
New Power Plant



Above—Pumps in river pumping station

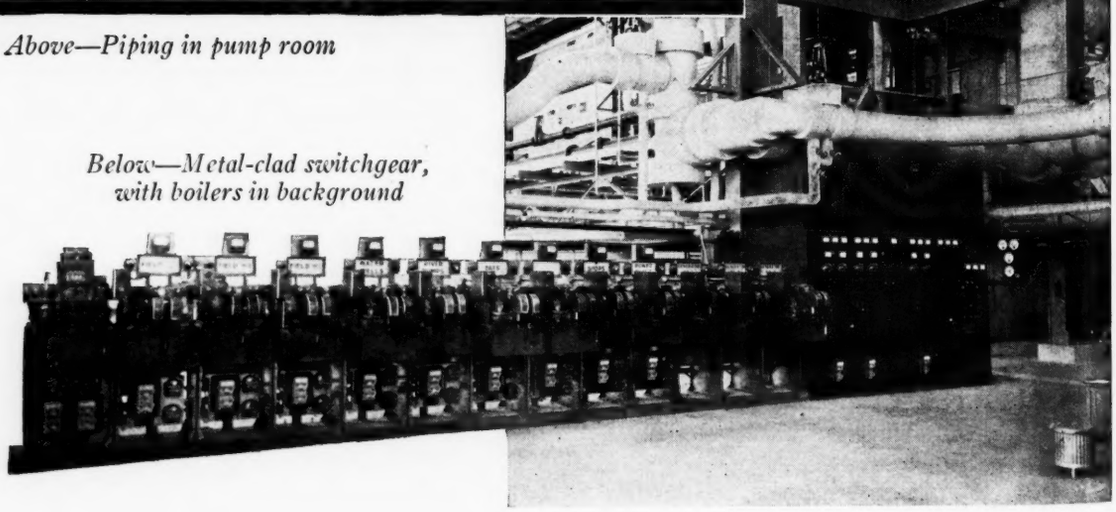


Above—Three-stage air-compressors and turbine-generators



Above—Piping in pump room

Below—Metal-clad switchgear, with boilers in background



Night makes little difference in the power load

Serves

TEXAS SULPHUR MINE

By G. G. Hollins

Mechanical Engineer
J. G. White Engineering Corp., N. Y.

Sulphur mining on the Gulf Coast of Texas is done by the Frasch process, in which water at a temperature above the melting point of sulphur is pumped into the ground and the resulting molten sulphur is raised by an air lift.

The wells are about 700 ft. deep, and each contains three concentric pipes, the outside pipe 6 in., the middle 3 in., and the inside 1 in. The outside pipe conveys hot water into the ground, the middle pipe carries up the molten sulphur and the inside pipe introduces the compressed air.

As the temperature of sulphur is raised above its melting point, it begins to thicken, and at a few degrees higher becomes too viscous to be pumped. The temperature must then be raised considerably before it is again fluid. It is necessary to use the lower range within which the temperature must be controlled accurately.

THE power plant of the Texas Gulf Sulphur Company, at Newgulf, Wharton County, Texas, is somewhat unusual, as its principal output is hot water at around 320 deg. F.

The initial installation of the power plant is designed to heat 3¾ million gallons of water per day to a temperature of approximately 320 deg. F.; to supply compressed air for the air lifts at 400 to 650 lb. per square inch; to furnish electric power for pumps and other purposes; and some steam for heating sulphur pipe lines, measuring tanks and pumps. The design provides for increasing the hot water capacity to double the initial amount, or 7 million gallons per day, and the building has been made of sufficient size for the additional boilers and other equipment, which is now on order and will be installed as rapidly as possible.

The power plant at present contains three supply water pumps of 300 g.p.m. each; four 70,000-gal. hot-process water softeners and heaters, three hot-water pumps, three mine-water heaters and three mine-water pumps, each of 1,500 g.p.m.; three 750-g.p.m. boiler-feed pumps, five 15,000-sq.ft. Stirling boilers; five forced-draft fans; three air compressors, each 1,040 cu.ft. per minute displacement; two 750-kw. and one 1,500-kw. non-condensing turbine generators, operating at 2,300 volts, 3 phase,

60 cycle. There is also a city water and field service water pump.

All the above pumps and fans are driven by direct-connected small steam turbines, and the air compressors are also steam-driven. Steam drive was chosen because of its reliability. All the exhaust steam is used in heating water for the wells or mines. The exhaust steam is not sufficient to meet requirements, and is supplemented by steam from the high-pressure mains through reducing valves.

Water is heated in two stages. The first stage is in the hot-process softeners, where it is heated with jet heaters designed to operate up to 20-lb. pressure. After passing through sedimentation tanks and filters, water for the mines is pumped to the mine heaters, which are of the jet type and operate with steam at 75 to 100 lb. direct from the boilers. From the mine heaters the water is pumped into the pipe lines to the wells, some of the latter being as much as 2½ miles from the power house.

Purification of the water presented quite a problem. The supply available is either from wells which are hard and contain sodium bicarbonate or from the near-by San Bernard River. That from the latter contains varying amounts of hardness, most of which is carbonate, and also a large amount of silt and organic matter. Suspended matter appears to be partly colloidal and is difficult to remove, especially when the hardness is low due to high rainfall in the stream's drainage area.

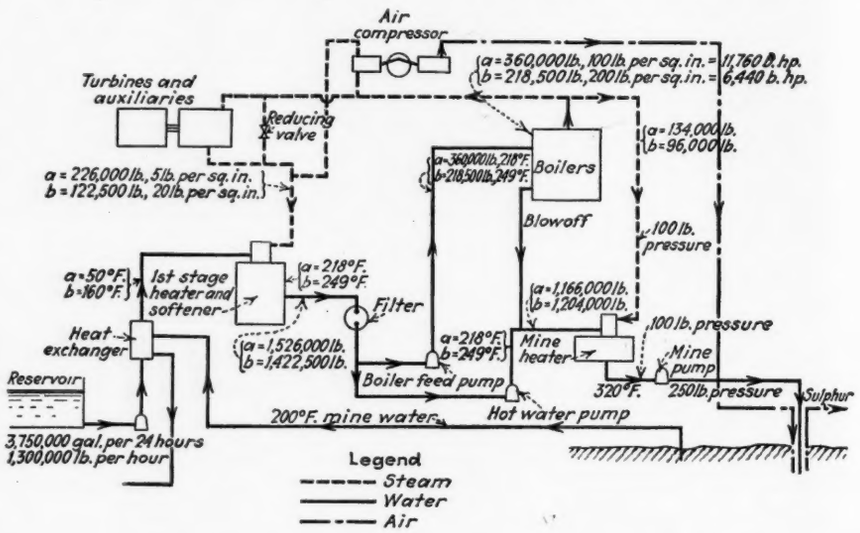
After studying samples of the water collected over a period of time sufficient to include varying conditions, it was decided to use the river water with so-called hot-process treatment, both for the mine-service and boiler-feed water. The latter is treated further to avoid embrittlement of the boilers by maintaining the proper sulphate-carbonate ratio.

The boilers are of the Stirling type, designed for 225-lb. pressure, set singly and fired by natural gas or oil. There are no superheaters, as the greater part of the steam is used for heating water, and as all the exhaust of the turbines is used in the heaters there is no advantage in further reducing their water rate.

Air-cooled furnaces have been provided, and at 200 per cent rating the air is heated to a little over 200 deg. F. This air is drawn through the settings by the forced-draft fans (one per boiler), which discharge into a common duct from which branches go to the burner wind boxes. The air-cooled parts of the settings are provided with auxiliary dampers to permit natural air circulation if the fan is out of service. No induced-draft fans are employed.

While the present fuel is natural gas with oil as a reserve, the installation is designed to be easily adapted to pulverized lignite. Settings have been made with sufficient furnace volume for this fuel, and provision has been made for the removal of ash. Also, the boiler-room steel work is designed to permit overhead bunkers.

The steam turbines and the steam ends of the compressors are arranged to operate with a range of pressure from 100 to 200-lb. gage and a corresponding exhaust pressure from 5 to 20 lb. The reason for changing the steam pressure is to maintain the heat balance when heat is recovered from the bleed water of the mines. When that water becomes warm, as it does after a deposit has been worked for some time, it is put through heat exchangers to preheat it for the wells. With warm water going to the first-stage heaters, the amount of exhaust steam that can be condensed in these heaters would be reduced unless the temperature range were kept the same. For that reason when the inlet temperature is raised, the steam temperature must be increased the same amount, which results in higher back pressure. Increasing the back pressure on the steam drives without change in the initial pressure would increase the water rate, and too large an increase would waste steam through the relief valve. To maintain the water rate and balance the exhaust steam, the inlet steam pressure can be raised as required. For the steam drives to be operated at a steam pressure different from the mine heaters, the boiler header is arranged in a ring and completely sectionalized and the steam piping made so that some of the boilers may supply the heaters while the remainder are supplying the steam-driven equipment.



Flow diagram for steam, water and compressed air

A pumping station, containing four 10,000-g.p.m. vertical motor-driven pumps, at the San Bernard River, about a mile away from the power house, supplies all the water used. The flow in this stream varies widely, the difference in elevation between low and high water being around 50 ft. The motors are installed above extreme high water, and the pumps are designed to be submerged when the elevation of the water is abnormal. High water does not last long, and the pump compartment is provided with de-watering equipment so that it may be cleared rapidly when the flood recedes.

Switchgear equipment in the power house is metal-clad, and motors in the pump house all operate at 2,300 volts, with the starting equipment for the motors in a steel cubicle structure.

Although it was desired to have both steam and water piping simple, it was considered necessary to loop and duplicate lines to provide for even a minor shutdown. A plant of this kind is different from most central stations or industrial plants, as it cannot be relieved of its load through connecting lines and there is no time in the life of the plant when any considerable shutdown would not mean a large financial loss.

PRACTICAL LAYOUTS

for

Diesel Cooling Systems

By L. A. Pease
Assistant Director of Engineering, Fairbanks, Morse & Company

DIESEL ENGINES are entitled to be properly installed and operated. But unfortunately, the cooling system is too frequently a makeshift affair, when as much thought should be given to it as to the engine itself.

Where the cooling water contains scale-forming ingredients that may deposit upon the engine water jackets—due to concentration in the cooling system, which is the result of evaporation of some of the water, or to the raw water that may pass through the engine jackets—it will be found profitable to install a heat exchanger for cooling the jacket water. The exchanger may be either of the coil or the shell-and-tube design.

When a commercial cooler or pipe-coil system is employed, there are two cooling water circuits. One of these, the soft-water system, includes the engine water jackets, the circulating pump, the space surrounding the tubes in a commercial cooler, or through the pipes of a pipe cooler, and the pressure tank. The raw water system includes the cooling tower or spray pond, the tubes of a commercial cooler, and the circulating pump. The pressure loss varies from 5 to 8 lb. per square inch for the former, and from 2 to 3 lb. per square inch for the latter, depending upon the exchanger design.

Based on a heat exchanger such as appears in Fig. 1, with seamless brass tubes and cast-iron shells and cores, the water needed per horsepower is shown in Table I. This contemplates for engines with uncooled pistons a soft-water outlet temperature of 140 deg. F. and a cooler raw-water inlet temperature of 100 deg. F. and 4,000 B.t.u. per horsepower per hour passing into the cooling system.

For two-stroke-cycle engines employing oil-cooled pistons a maximum engine outlet water temperature of 140 deg. and a maximum raw cooling water inlet to cooler of 100 deg. F., is usual, upon which conditions Table II has been prepared. The heat absorption is computed as 3,025 b.t.u. per horsepower per hour for jacket water and 750 B.t.u. per horsepower per hour for piston-cooling oil, making a total of 3,775 B.t.u. per horsepower per hour to be removed by the cooling system.

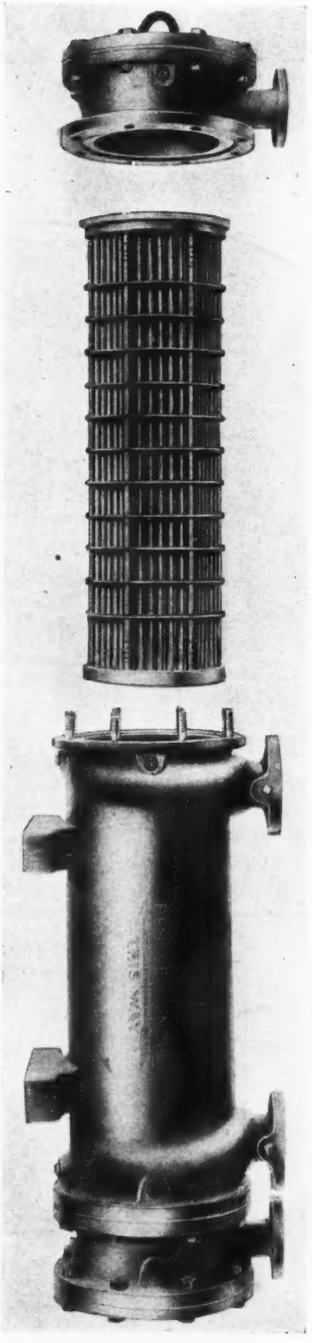


Fig. 1—A type of shell-and-tube cooler in general use

Installation of a commercial cooler is quite simple. It is usually placed near the engine and pump, where there is sufficient room to permit removal of the bundle of tubes for cleaning, preferably under a crane or hoist in a vertical position. It should be solidly bolted to the wall or floor with pipe connections so arranged that no strains will be placed on the cooler.

In a great number of plants the jacket water is cooled in pipe coils similar to an ammonia cooler in a refrigerating plant. Various combinations are used and are entirely satisfactory. However, a 2-in. pipe is in most general use, taking about 5 feet of 2-in. pipe per engine horsepower. A satisfactory arrangement is shown in Fig. 3. This consists of pipe stands 12 pipes high, spaced 6 in. apart, with the stands spaced 12 in. apart. Return bends are used at each end and connected through unions to headers. In cases where the friction loss of water through coils must be low, additional headers can be used and connected to the main piping system at small expense.

The pipes are usually clamped to a set of standards, which also hold the distributor pipe for the raw water. This may be a standard slotted pipe or some form of patented dis-

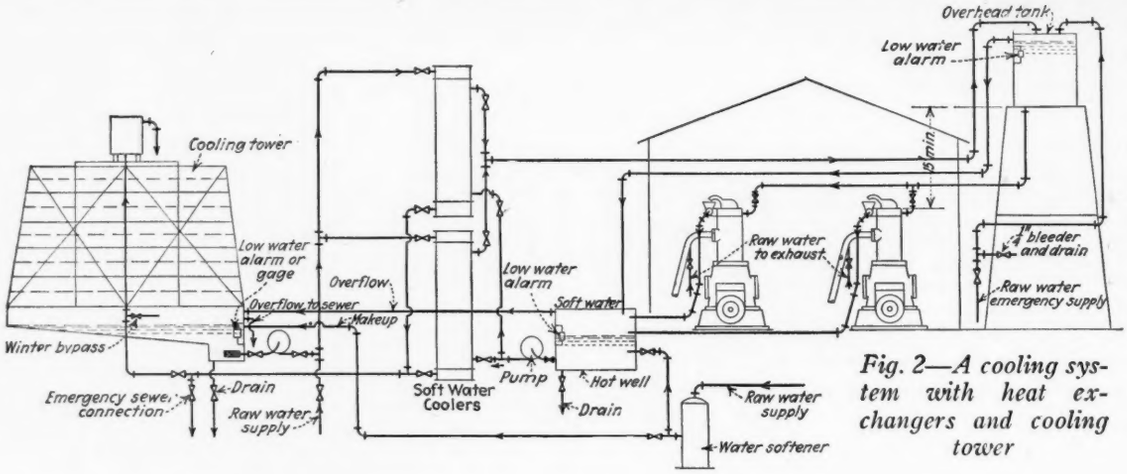


Fig. 2—A cooling system with heat exchangers and cooling tower

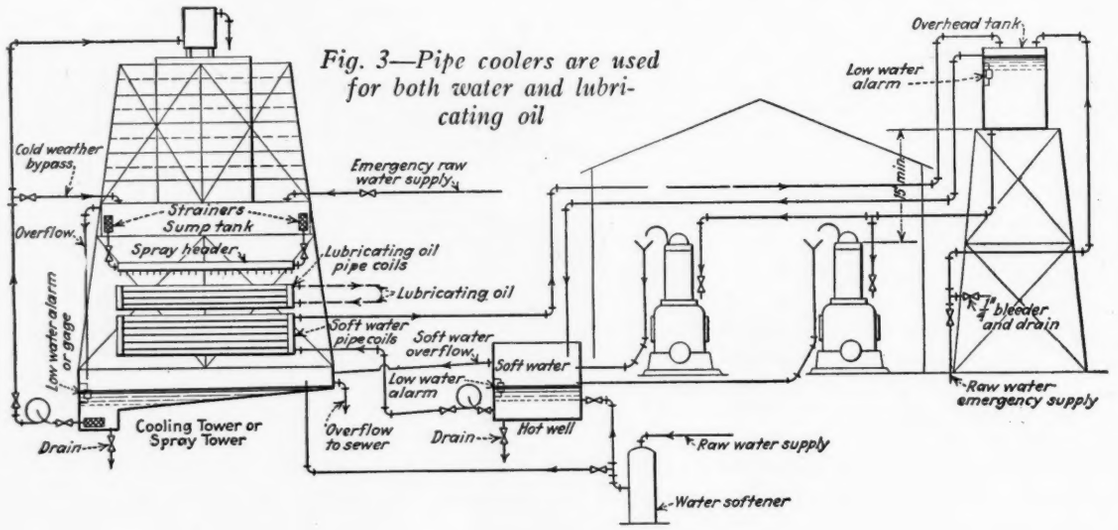
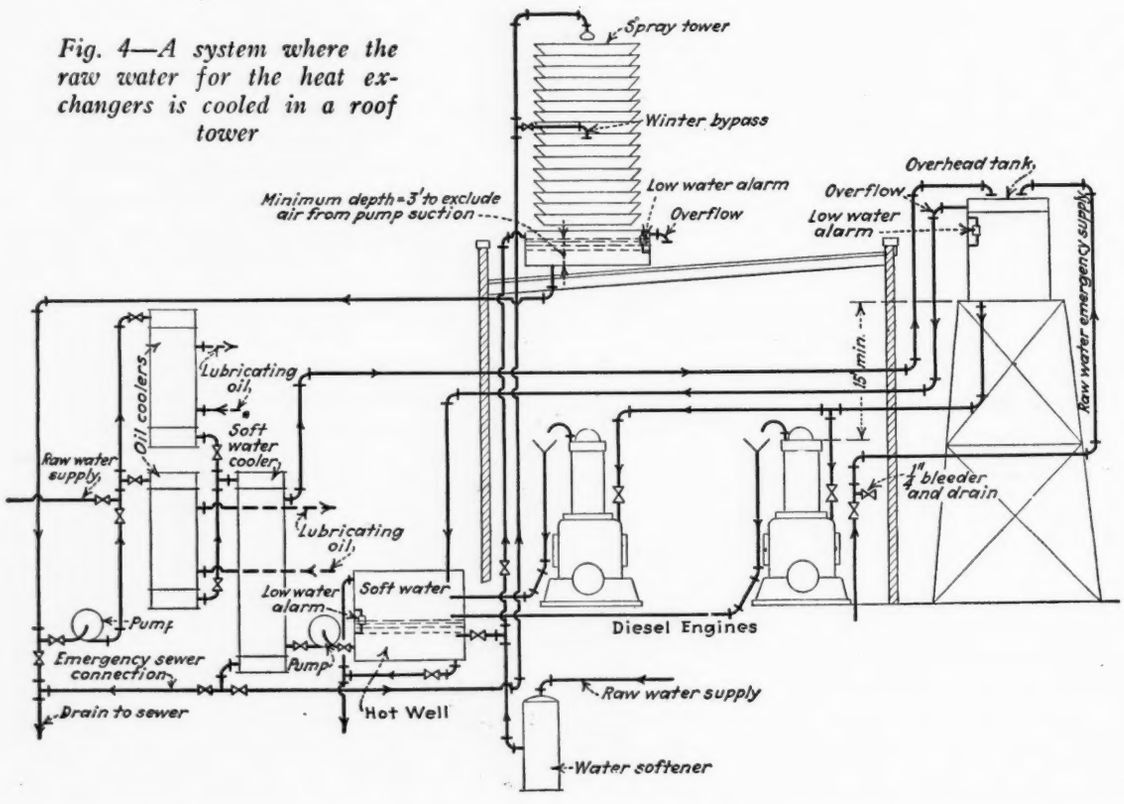


Fig. 3—Pipe coolers are used for both water and lubricating oil

Fig. 4—A system where the raw water for the heat exchangers is cooled in a roof tower



tributor. The object is to permit the water to flow over the entire outside of the pipe immediately below and drip to the next one, covering the entire exterior surface of each pipe as the water flows downward.

The set of racks is mounted in or over a basin, usually of concrete, so arranged with a sump that the raw-water circulating pump will get its suction without air. The pump usually takes the raw water from the basin and discharges it over the cooling tower, which may be located above the cooling stands, as shown in Fig. 3, where pipe coolers are used for both water and lubricating oil.

To prevent waste of cooling water, louvers should be placed on all four sides, or if the prevailing wind is from one direction louvers can be placed on two sides only and still be effective.

TABLE I—HEAT REMOVED WHEN ENGINE HAS UNCOOLED PISTONS

Engine Horsepower	B.t.u per Hr. Extracted by Exchanger	Soft Water Circulated, Gal. per Min.	Raw Water, Gal. per Min
50	200,000	25	25
65	260,000	32.5	32.5
100	400,000	50	50
130	520,000	65	65
200	800,000	100	100
300	1,200,000	150	150
400	1,600,000	200	200
540	2,160,000	270	270
720	2,880,000	360	360
840	3,360,000	420	420
1,000	4,000,000	500	500
1,200	4,800,000	600	600
1,400	5,760,000	720	720
1,600	6,400,000	800	800
1,800	7,200,000	900	900
2,000	8,000,000	1,000	1,000

As a continual flow of water is essential to the proper operation of any cooling system, great care must be used in choosing the cooling-water pump. Piston pumps must be used where there is a lift to the pump suction. When centrifugal pumps are used, the static level of the water on the suction side must, in general, be higher than the top of the pump. This is necessary because the pump should never be allowed to lose its prime and permit the engine water jackets to be emptied. However, it is possible to obtain self-priming centrifugal pumps.

Pumps are generally electric-driven by squirrel-cage motors, although in small plants they are sometimes driven from the engine's extension shaft. Pump motors should be connected to a panel directly on the station bus, so that only an interruption to the total power supply can open the pump circuit. No attempt should be made to operate the cooling system by thermo-syphon, since that requires a large quantity of water and positive circulation cannot be maintained.

TABLE II—HEAT RECEIVED FROM ENGINES WITH COOLED PISTONS

Engine Horsepower	Total B.t.u. to Coolers	Heat From Oil Cooler, B.t.u. per Hr.	Heat from Jacket Water Cooler, B.t.u. per Hr.	Water Circulated, Gal. per Min.
560	2,114,000	420,000	1,694,000	241
700	2,642,500	525,000	2,117,500	301
840	3,171,000	630,000	2,541,000	361
1,000	3,775,000	750,000	3,025,000	430
1,200	4,530,000	900,000	3,630,000	516
1,400	5,285,000	1,050,000	4,235,000	602
1,600	6,040,000	1,200,000	4,840,000	688
1,800	6,795,000	1,350,000	5,445,000	774
2,000	7,550,000	1,500,000	6,050,000	860

Any standard piston pump may be used provided it is reliable and is properly installed. Where continuity of service is of great importance, there should be a duplicate pump.

Although not in common use for stationary plants, the radiator-type cooler possesses merit. It is used almost exclusively for automotive engines and railway Diesels, and is now being applied generally on dredge and drag-line Diesels. Some small stationary plants are employing radiators for cooling the water, but not in sufficient number to warrant any general recommendation. For special cases radiator makers have been able to produce equipment at a price to permit them to compete with closed coolers. Undoubtedly development and experience will permit more economic manufacture and create a field, beginning with the smaller plants, where auxiliary cooling equipment cost is a comparatively large percentage of the total cost of the installation.

One cooling circuit for a standard Diesel unit employs a radiator and circulating pump. This is similar to an automotive arrangement and works satisfactorily in small plants.

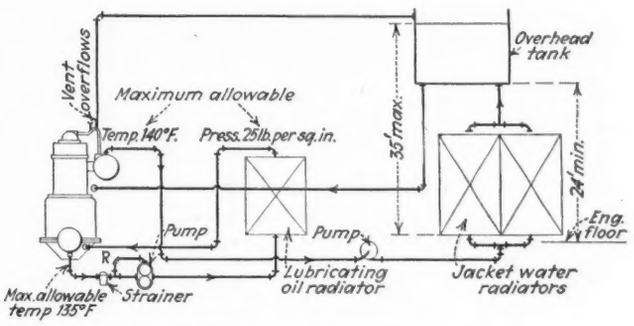


Fig. 5—Diagrammatical outline of a radiator system

A layout of radiator cooling for a large Diesel engine employing oil cooling in addition to a water cooler appears in Fig. 5. It requires a special heavy radiator for the oil and a water radiator designed to withstand the maximum pressure. The oil radiator must withstand the maximum pressure required to force the oil through it on a cold day, when the oil is quite viscous.

Arrangements for different connections can be made for various systems. In each case however, the maker of the radiator should be given all the technical data and pipe layout, so he can figure the proper radiator to adequately remove all heat received by the jacket water from the burning gases in the cylinder.

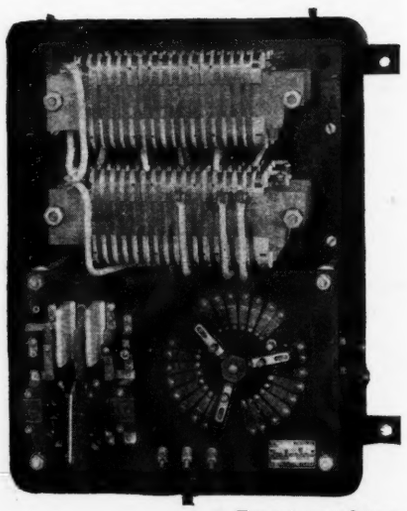
Arrangement can be made to use the heated air from the radiator by directing it into ducts for heating and process work or by bypassing it out of doors when necessary. This can be automatically or manually controlled. If the engine discharge is not vented or tapered upward to the outlet, a sump must be put in between the engine and pump suction to relieve the air, unless a piston pump is used.

Leveling an Engine

WHEN installing a horizontal engine, usually it is possible to level the frame by a spirit level placed on the main bearing housings, for the top surfaces of the housings are machined parallel with the plane of the crank and cylinder center lines. By placing the level parallel with the shaft line the frame can be trued up transversely, while placing it across the top of the two throws and parrallel with the cylinder allows the discrepancy that exists longitudinally to be corrected. It is necessary to check the results by leveling both housings and rechecking the process. A few engines have a true surface machined on the top of the crosshead guide to facilitate the work of leveling.

APPLYING A.-C. MOTORS to FAN DRIVES in BUILDINGS

By H. L. SMITH
Industrial Engineering Department
General Electric Company



Preset speed control for slip-ring motor driving fan

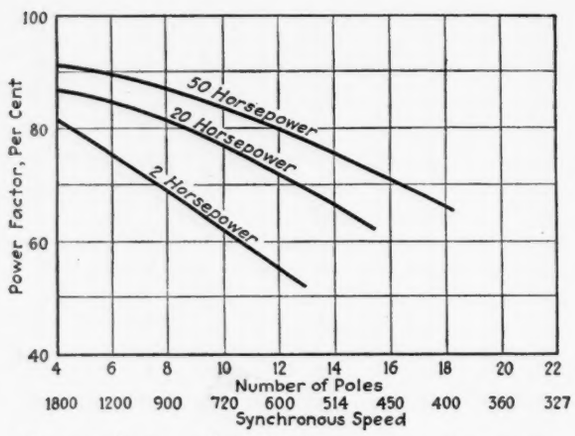
Alternating-current motor applications to building fans involve engineering problems not encountered with direct current. In this article types of alternating-current motors available; the most economical motor to use; drive for connecting the motor to the fan; and type of control to use are considered

◆

UNTIL recent years tall buildings were built where direct current was usually available. Such buildings are now erected where alternating-current only is supplied. The number and sizes of applications of electric drive in buildings are increasing, owing to more extensive use of forced ventilation, refrigeration, water pumping, elevators and many other services. Thus the demand for alternating-current drives is expanding and selection is becoming more important.

Fans for ventilation may be divided into two classes: propeller or disk types; and centrifugal housed types. Propeller fans are best suited for ventilation where air resistance is low and practically constant. They will handle large volumes of air at pressures below $\frac{1}{3}$ in. of water, and are commonly used for free air circulation, such as exhausting from rooms and on unit heaters. They cannot be used on duct systems or with dampers, as the air loss increases with the air resistance. Propeller fans are generally furnished with their motors as complete units. The motors are totally enclosed and the fan impellers are mounted on the motor shafts. Single-phase motors are used where variable capacity is required, which is secured by using a controller to reduce the motor's speed. Polyphase motors are usually constant-speed machines.

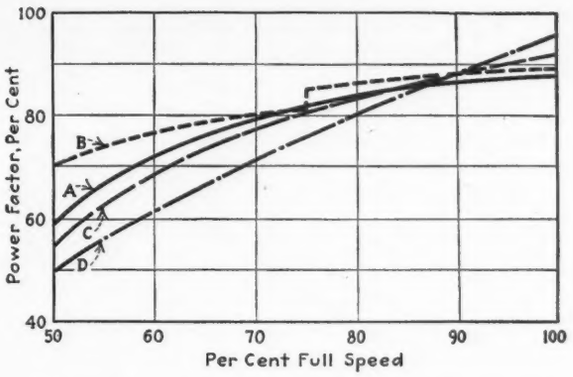
Centrifugal housed fans include steel-plate, forward-curved, and backward-curved blade types. They are suitable for supplying air through ventilating systems against air pressures up to several inches of water. In building ventilation, large volumes of air are handled at relatively low pressures. Centrifugal housed fans to meet such conditions efficiently operate at low speeds, from 94 to 600 r.p.m. The direct-current motor is well suited for direct connection at low speeds. Alternating-current induction motors, however, are not. The price per horsepower goes up rapidly as the rated motor speed decreases: on a 600-r.p.m., wound-rotor induction motor, for instance, it will be from 150 to 200 per cent of that of a 1,200-r.p.m. motor having the same horsepower. The power factor of low-speed, alternating-current motor is relatively low. The curves on this page show how full-load power factor grows worse as synchronous speed decreases. With the growing tendency to have a penalty in power rates for poor power factor, this question becomes increasingly important. Direct-current motors' maximum speed is always adjustable to some extent by field control, while alternating-current motors' maximum speed is determined by the synchronous speed of the motor used. The latter means that



Power factor of induction motors decreases, the lower the rated speed

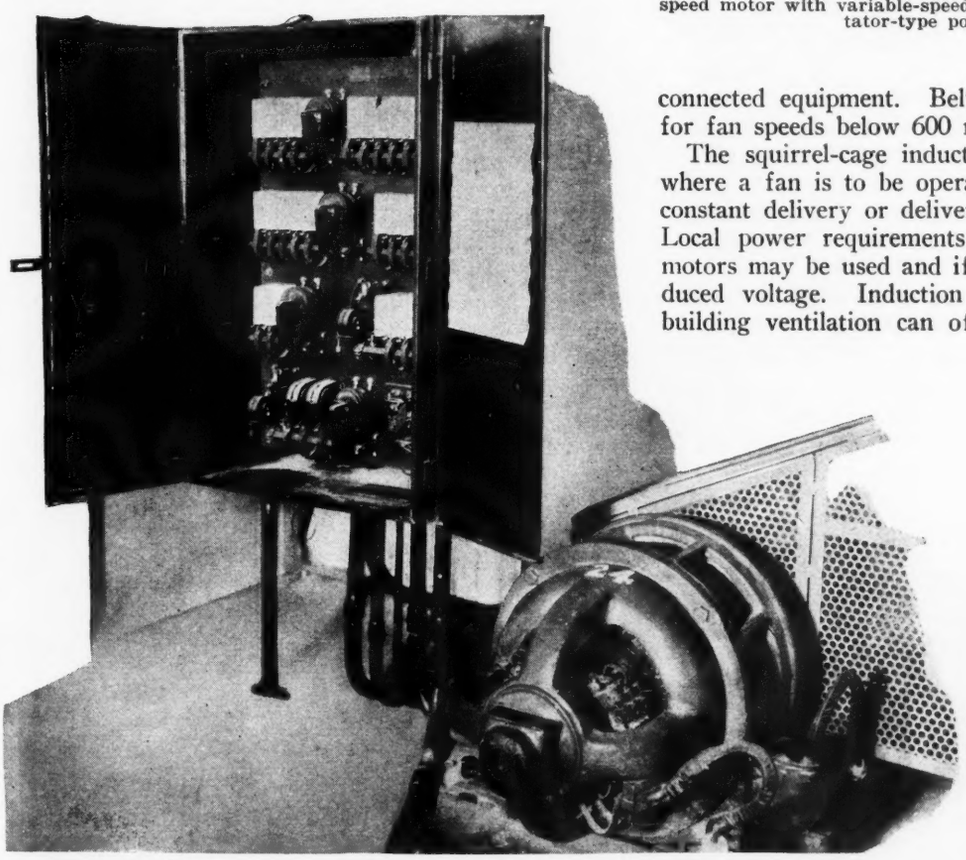
with direct-connected units an alternating-current motor must be selected that has a synchronous speed nearest the maximum fan speed desired. In selecting alternating-current motors for driving fans, it must be decided whether the motors are to be direct connected or belted and if they are to be of the constant-speed or adjustable-speed type.

Direct-connected motors generally make the most compact installation. Connecting motors to loads by belts or other short-center drives allows using higher-speed motors on slow-speed fans, and the initial price of the motors is lower. The power factor of medium and high-speed induction motors is better than that of slow-speed types, and a belt ratio can be selected to operate the fans at their most efficient speed. If, after installation, air pressure conditions are different from those estimated, fan speed can be adjusted at small expense by changing the pulley ratio. Medium-speed induction motors generally can be built to operate more quietly than low-speed motors.

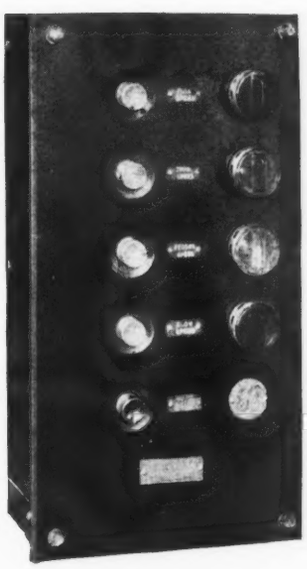


Power factor of alternating-current motors driving fans

Curve *A* is for a wound-rotor induction motor. Curve *B*, multi-speed induction motor and damper control. Curve *C*, constant-speed motor with variable-speed transmission. Curve *D*, commutator-type polyphase motor.



Left—Remote speed controller for slip-ring type motor driving a fan.

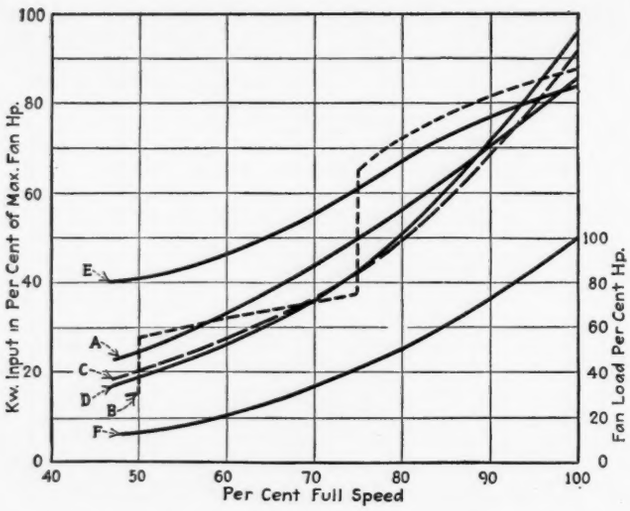


Right—Push-button station for remote speed control.

Belted motors are more easily insulated from the building structure than direct-connected units, and thus minimize possible transmission of motor noise. Even when the magnetic hum in an induction motor is low, if it is solidly connected to its foundation, a hum inaudible in the fan room may be transmitted through the steel work and concrete of the building. The noise may be magnified objectionably at some point on the lower floors if the building structure has the correct frequency to amplify this sound, consequently the question of noise transmission is an exceedingly important one. Further, with short-center drives, the floor space required can be made practically as small as that taken up by direct-connected equipment. Belted drives are recommended for fan speeds below 600 r.p.m.

The squirrel-cage induction motor is the best drive where a fan is to be operated at constant speed either constant delivery or delivery varied by damper control. Local power requirements may govern whether these motors may be used and if they must be started on reduced voltage. Induction motors for fans used in building ventilation can often be started on full voltage, but it is preferable to use reduced voltage for starting, as it decreases maintenance on belt drives.

In most applications it is necessary to vary the air flow. With alternating-current motors this can be done by using: (1) wound-rotor induction motors with resistance control; (2) two-speed or multi-speed squirrel-cage induction motors with or without damper control;



Kilowatt input to alternating-current motors driving fans

Curve *A*, wound-rotor induction motor. Curve *B*, multi-speed motor and damper control. Curve *C*, constant-speed motor with variable-speed transmission. Curve *D*, commutator-type polyphase motor. Curve *E*, two-speed motor and damper control. Curve *F*, fan horsepower.

(3) constant-speed motors with variable-speed transmission; (4) adjustable-speed alternating-current commutator motors.

In general, for the sizes of equipments required for building ventilation, it will be found that the wound-rotor motor with resistance control makes the most economical unit. The main disadvantage of the wound-rotor is low efficiency at reduced speed. However, the power required by fans is also relatively low at reduced speeds, so that the kilowatt loss is not as high as might be expected. The curves on this page show the relative kilowatt input to the various types of motors. No general statement can be made as to the relative efficiency, as it depends upon the conditions of operation.

For example, consider a fan requiring 50 hp. at maximum speed, and assuming an average cycle of operation where full volume is required for 2 hr. per day, 85 per cent volume 2 hr. per day, 75 per cent volume 2 hr. per day, and 50 per cent volume 3 hr. per day—the relative power consumed would be: for a wound-rotor induction motor, 235 kw.-hr. per day; a multi-speed motor without damper control, 234 kw.-hr.; a multi-speed motor with damper control, 223 kw.-hr.; a constant-speed motor with variable-speed transmission, 221 kw.-hr. per day; and an alternating-current brush-shifting motor, 228 kw.-hr. per day.

If the cycle of operation is full volume for 1 hr. per day; 75 per cent volume 4 hr. per day; and 50 per cent volume 4 hr., the relative power consumed will be: for a wound-rotor motor, 189 kw.-hr. per day; a multi-speed motor, 147 kw.-hr.; a constant-speed motor with variable-speed transmission, 170 kw.-hr.; and a brush-shifting motor, 171 kw.-hr. per day.

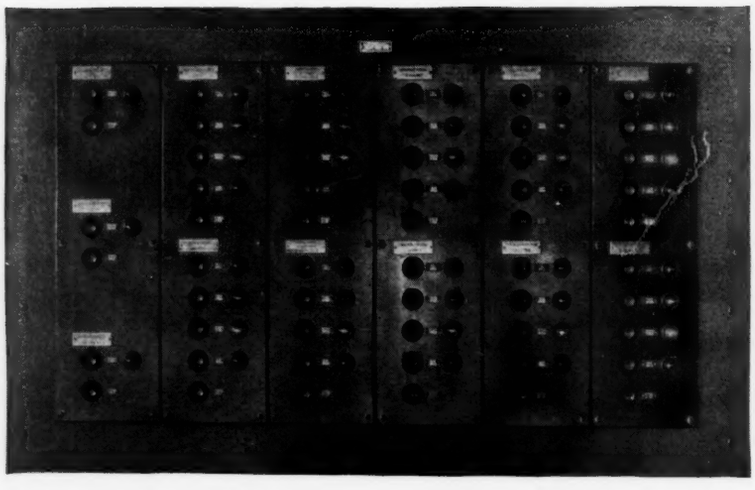
The multi-speed motor shows up to the best advantage when the air flow required permits the fan to operate with the dampers fully open at the three motor speeds. This occurs in the second cycle, where the volumes of air required are full, $\frac{3}{4}$ and $\frac{1}{2}$ maximum. Under these conditions the multi-speed motor shows a considerable saving in power, which would justify its use.

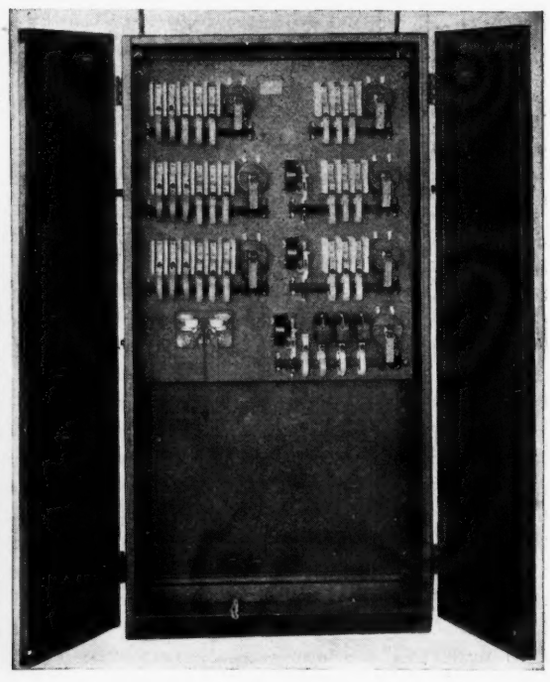
For the conditions in the first cycle, where the air volumes required are not exactly full three-fourths and one-half maximum, the multi-speed motor must run at speeds that will supply more air than is necessary or the air flow must be reduced by dampers. Under these conditions, a multi-speed motor shows practically no saving over the wound-rotor motor. The latter also has the advantage of low starting current, and offers any reasonable number of speeds, which can be adjusted if necessary by changing the taps on the rotor resistor. Thus control is flexible and simple. In general, a multi-speed motor with control will be slightly more expensive than a wound-rotor motor with control; therefore, even for conditions of operation such as covered in cycle No. 2, the wound-rotor motor is preferable.

A limitation of two-speed and multi-speed motors is the fixed ratio of reduced speed to maximum speed. For example, on 60-cycle circuits the speed combinations are 1,200 and 600; 900 and 450; 720 and 360; 1,200, 900

Left—Four-speed indicating alternating-current fan-motor controller.

Below—Bank of push button remote control stations for motor drives.





and 600; 900, 600 and 450; 900, 720 and 450 revolutions per minute.

A constant-speed motor with variable-speed transmission gives a wide-range of speed, but the overall efficiency at reduced speed is low, because the fan horsepower decreases rapidly, as its speed is reduced. At one-half volume, the theoretical fan horsepower is 12½ per cent of that at maximum speed. Efficiencies of the motor and the variable-speed transmission are reduced at light loads, and power input is little less than that of the wound-rotor motor with resistance control.

An alternating-current commutator motor gives an efficiency at low speed slightly better than that of the constant-speed, squirrel-cage motor with variable-speed transmission. However, the cost of both the commutator motor and the constant-speed motor with variable-speed transmission is so high compared with the wound-rotor that they are not ordinarily justified. How the power factor of the different types of motors driving fans is affected by changes in speed is indicated by the curves at the top of page 247.

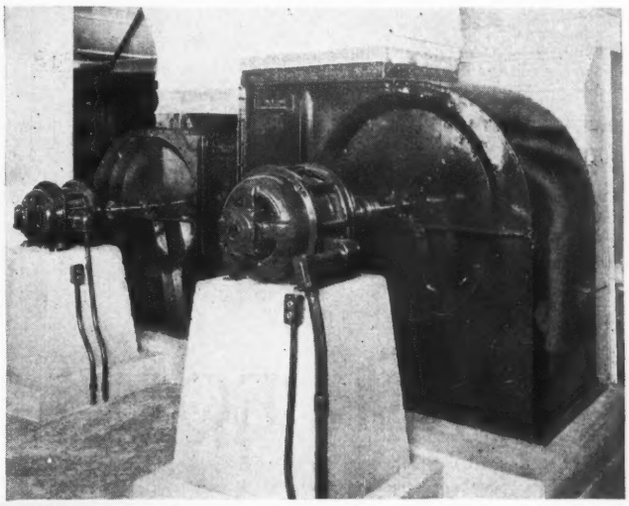
Various standard types of control are available for squirrel-cage induction motors, such as manual reduced-voltage starters, automatic reduced-voltage starters and magnetic switches for full-voltage starting.

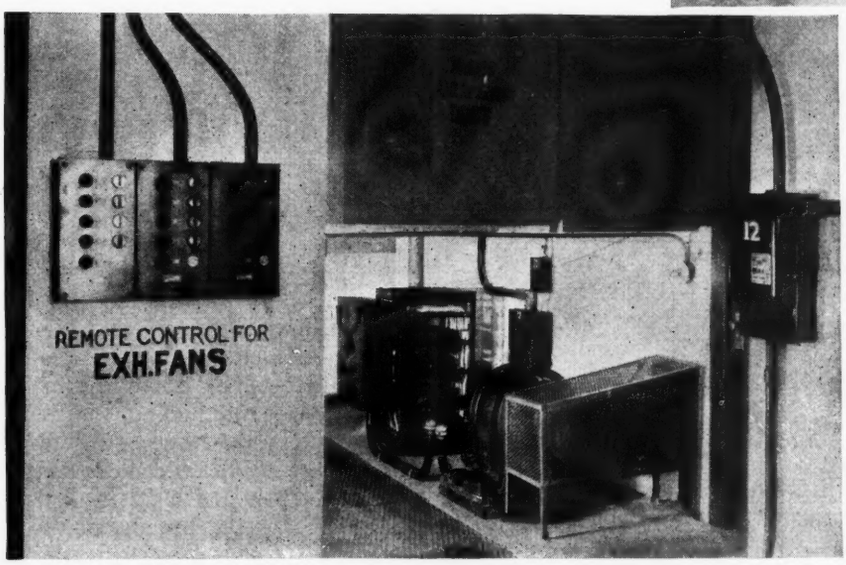
Wound-rotor motors may have the primary circuit controlled from an oil switch or magnetic switch operated from a push button, with a hand-operated drum controller or dial switch for cutting out starting and regulating resistance in the secondary. However, the remote indicating-speed type and the pre-set speed-control type are particularly applicable for building ventilation equipment.

The remote indicating speed control consists of a line contactor with temperature overload relay and three accelerating and regulating contactors with starting and regulating resistor. Equipment is controlled from a five-button station marked slow speed, second speed, third speed, full speed, and stop. When any of the speed buttons is pressed, the motor starts and accelerates automatically to that speed. There are indicating lights at the control station, of different color for each of the four speed buttons. When a button is pressed the corresponding lamp is lighted, indicating the speed for which the control has been set. Speed can be changed while the motor is running by pressing the button corresponding to the speed desired. This arrangement permits starting, stopping and changing the speed of the fan from the control station, located at any convenient point, and is especially suitable where the fans are not readily reached or where the speed is changed frequently.

The pre-set speed control permits starting and stopping from a control station conveniently located, the fan always being accelerted to the particular speed for which the controller is set. To change this speed requires going to the controller, to alter the setting, usually by means of a dial switch located on the panel.

The photographs show a remote indicating-speed controller, a pre-set speed controller, a central-control station for several fans using remote indicating-speed controllers and other applications.

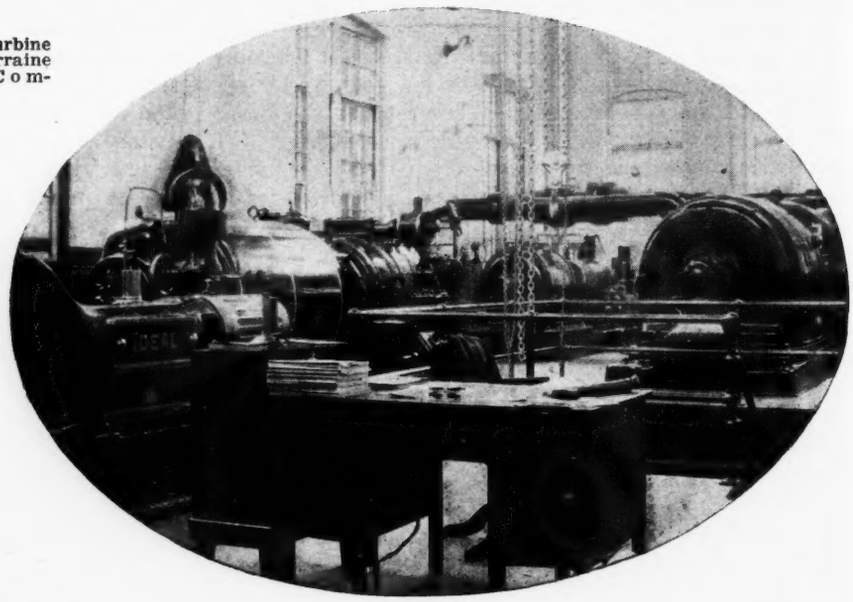




Above — Squirrel-cage motors driving fans in the Union Trust Building, Detroit. Note push-button stations located near the motors.

Left—Speed-indicating push-button remote control for exhaust fan motors in Mosque Theater, Newark, N. J.

A CORRECTION—in Jan. 21 number of *Power*, second column, page 89, the statement is made: "No definite figures are yet available on the actual amount of steam so generated, but it is estimated that a minimum of 2,000 lb. per ton of pulp produced will be generated." The amount of steam is 9,000 lb. per ton of pulp produced, not 2,000 pounds.



Reconditioned turbine room of the Lorraine Manufacturing Company.

REPLACING POWER EQUIPMENT SAVES $36,000 *A Year*

The improvements made to the power house by this textile mill is typical of the work being done in many of New England's industrial power plants

EARLY IN 1927 the Lorraine Manufacturing Company, Pawtucket, R. I., was faced with the necessity of increasing the capacity of its generating equipment in order to supply the growing electrical load in the mills due to the addition of a worsted finishing plant and the electrification of various mill drives. Growing out of this need a reconditioning program in the power plant was carried through which has resulted in an annual saving of $36,960, representing a return of 18.5 per cent on the cost of the new work.

The Lorraine mills have an enviable record of 50 years in the manufacture of worsteds, cotton, silk and rayon fabrics. At present 2,600 persons are employed.

The operation of the plant requires nearly 3,000-kw. to drive the various machines, and large quantities of steam for dyeing, finishing and heating.

Twelve years ago the power and steam requirements were furnished by two plants, one serving the cotton division and the other serving the worsted division. As the mills grew the power services were centralized by discontinuing the plant serving the cotton division and installing its four vertical fire-tube boilers in the worsted plant, together with new boilers and a 1,500-kw. extraction turbine.

Additions were again made to the capacity of the centralized plant in 1924, after which the generating equipment consisted of a 200-kw. and a 1,500-kw. turbine, both operated condensing, the larger unit arranged for bleeding steam at 10-lb. pressure. There was also a 26 x 52 x 60-in. stroke corliss engine, which drove a line shaft through a 60-in.-wide belt and a 24-ft.-diameter flywheel. It also drove a 275-kw. synchronous generator. The engine exhausted to a 900-kw. condensing turbine, which, in effect, made a triple expansion unit.

In the boiler room were sixteen upright fire-tube boilers, all oil-fired. Eight of these contained 2,500 sq.ft. of heating surface, four had 4,000 sq.ft. and five 5,000.

Again in 1927 the mill requirements for power and steam approached the capacity limit of the plant, which, together with increasing power costs, made it evident that purchased power would have to be resorted to or the present plant reconditioned. However, records indicated that even with purchased power the boilers would still have to operate at 60 per cent of their previous capacity. With such a demand for process steam, purchased power appeared uneconomical provided improvements were made to the power plant. The situation was difficult, as it came at a time when textile capital was being conserved and used only when the need was urgent.

The appropriations then available for power plant changes precluded the purchase of a new turbine-generator set. However, a favorable turn in affairs came

when it was learned that a 3,000-kw. condensing turbine could be purchased from the North Adams Electric Light Company, together with auxiliaries, foundation and estimated erection cost, for $58,503. As the unit was of about the capacity required, its purchase was decided upon to replace the corliss engine, which had seen 40 years of continuous service.

Then came the problem of installing the unit without interrupting the operation of the corliss engine. The first task was the erection of the old foundation steel, the only changes necessary being a slight shortening of the columns to accommodate the present turbine room elevation. The condenser and auxiliaries were then installed and the old concrete foundation placed upon the steel work. The difficulties involved in this work were many, and it had to be carried on with great care. In the picture of the turbine room the railed-in well marks the location of the old engine. As the clearance between the 60-in. face flywheel and the turbine foundation was only six inches and since most of the erection work had to be done while the engine was in operation, the need for care and caution is obvious.

It was desirable that steam be bled for heating and process requirements, but the unit purchased had not been designed for this purpose. However, the turbine had two inspection hand holes, which permitted steam to be extracted from between the first and second impulse blades. These were piped to a reducing valve, from where steam at 10 lb. is delivered to the low-pressure system feeding the dye house, and to the water heaters.

Attention was next turned to the boiler room, which then contained sixteen oil-fired upright fire-tube boilers. All were old, and the maintenance work necessary to keep them in operation was as much as $8,000 a year. In fact, it kept the maintenance crew busy renewing staybolts and fixing leaks in order to keep enough boilers in service to supply the steam load.

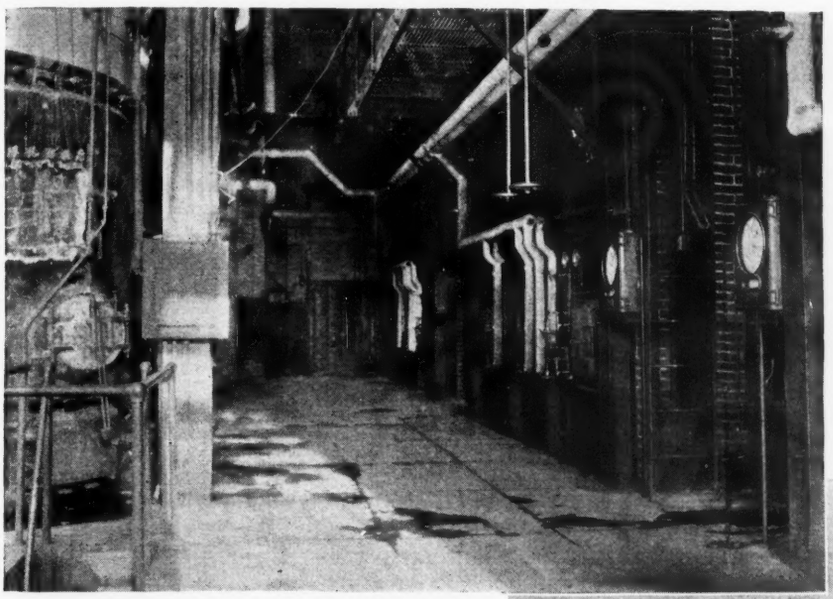
The program in the boiler room first required that the dividing wall between the boiler and turbine room be torn down and rebuilt sixteen feet back into the turbine room to make room for the larger modern type of boilers.

The new boilers, each containing 7,370 sq.ft. of heating surface, are of the cross-drum type, designed for a working pressure of 225 lb. and equipped with superheaters to deliver steam at 125-deg. superheat. In spite of having moved the division wall, it was necessary to place the new boilers within seven inches of it, openings being left in the wall so that the tube inspection doors could be opened into the turbine room.

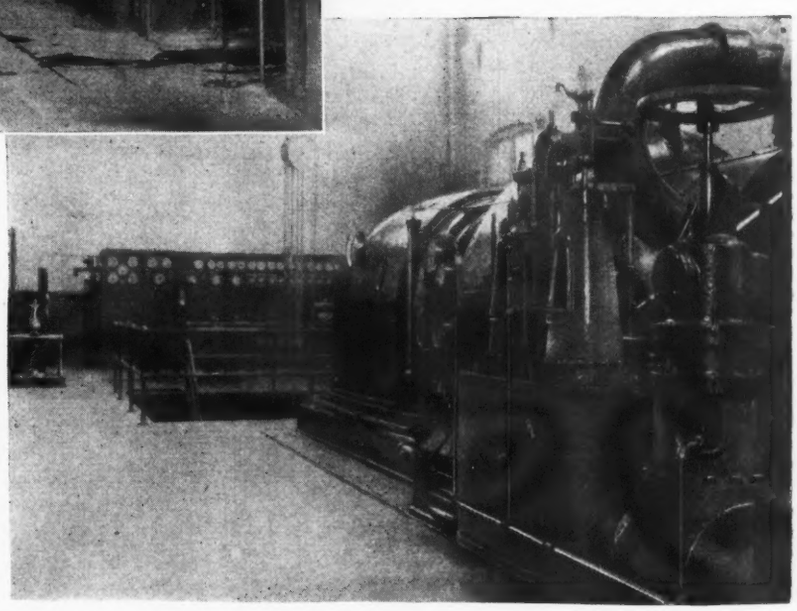
The boilers were set with the high end of the tubes toward the turbine room and the drum and low end of the tubes at the firing aisle. Although this necessitated placing the oil burners so that the flame enters the low end of the combustion chamber, it nevertheless brings the feed-water, blowdown, and water column convenient to the firing aisle.

Six oil burners have been installed per boiler. They have sufficient fuel-burning capacity to produce 250 per cent rating. The fuel-oil heating and pumping equipment used for the old boilers was retained and adapted to the new service.

The boilers have been set 15 ft. 6 in. high at the firing end and 19 ft. 9 in. high at what is ordinarily the front



Right—The new boilers at the right of the picture have replaced vertical boilers similar to that at the left.



Turbine room, showing switchboard and bleeder connection to the 3,000-kw. turbine

end. The furnace is 14 ft. 3 in. wide and 15 ft. 6 in. long. The side walls, back and bottom are of hollow air-cooled construction. Air for combustion passes down the back and sides through the hollow furnace floor and up the front to the burners. The old stack, 175 ft. high and 10 ft. in diameter at the top, furnishes a maximum draft of about ½ in. at the boilers, which will produce about 200 per cent rating when all of the air passes through the hollow setting. By opening dampers just above the burners additional air may be admitted and the rating increased to 250 per cent.

As in the turbine room, the boiler installation had to be made without interrupting the steam supply. Three 2,500-sq.ft. and two 4,000-sq.ft. old upright boilers were removed to make room for two of the new boilers. After these had been placed in operation during October, 1928, seven more of the old boilers were removed to make room for a third new boiler, which was put into service in September, 1929, thus completing the changes in the power plant for the time being. By removing the remainder of the old boilers, now used only as emergency stand-by, room will be available for additional new boilers of the same size should an increase in steam demand require additional capacity.

During the winter only about 36 per cent of the total steam generated is used for power, the remaining 64 per cent being required for process and building heating. Process steam for the cotton division is supplied to the plant at boiler pressure after being measured by a Venturi meter. Steam for the worsted mill and finishing plant, likewise metered, is supplied at 75 lb., which is later reduced to 10 lb. The steam bled at 10-lb. pressure from both the 1,500- and 3,000-kw. turbines is also metered, and used mostly for building heating, which is both steam and forced hot water.

All of the fuel oil supplied to the boilers is metered and its temperature recorded. Venturi meters measure the water fed to the boilers, and boiler meters record the steam flow, the air flow, and the flue gas temperature. From the data furnished by these instruments a daily record of all fuel used, water consumed, power generated and steam furnished to the various mill departments is kept, thus enabling the cost of power and steam service to be easily determined.

BOILER ROOM EXPENSE

Date	Fuel	Operating Labor	Repairs	Supplies	Total	Pounds of Steam for Power	Pounds of Steam for Manufacturing	Cost per 1,000 Lb. of Steam
1928								
Jan. 7	4,418.40	131.96	71.79	152.83	4,774.98	2,775,000	9,636,400	.4973
14	3,393.60	134.80	57.14	133.15	3,718.69	2,474,000	7,540,000	.4932
21	3,647.15	138.19	69.21	114.84	3,969.39	2,641,000	8,650,000	.4988
28	3,700.62	136.94	65.34	152.83	4,055.73	2,613,000	8,949,000	.4532
1929								
Jan. 5	2,587.20	133.08	39.72	79.65	2,839.65	2,795,000	8,997,700	.3155
12	2,598.00	132.32	9.26	86.16	2,825.74	2,875,000	9,157,900	.3085
19	2,623.20	134.93	19.91	76.11	2,854.15	2,755,000	9,267,900	.3079
26	2,712.00	124.69	11.10	121.53	2,969.32	2,855,000	9,435,500	.3146

TURBINE ROOM EXPENSE

	Steam	Operating Labor	Repairs	Supplies	Total	Kw.-hr. Generated	Cost per Kw.-Hr.
1928							
Jan. 7	1,380.01	127.13	....	1.10	1,508.24	136,500	.0110
14	1,220.67	123.78	....	95.12	1,439.57	115,500	.0124
21	1,211.69	127.53	....	13.71	1,352.93	124,700	.0100
28	1,184.21	125.95	....	13.02	1,323.18	124,100	.0100
1929							
Jan. 5	881.82	129.22	9.50	37.09	1,057.63	137,500	.00769
12	886.94	127.80	2.85	22.98	1,040.57	141,500	.00735
19	848.26	132.68	....	34.06	1,015.00	135,500	.00749
26	898.18	112.84	3.10	15.42	1,029.54	140,500	.00732

The table gives boiler and turbine room operating cost data for the month of January in the years 1928 and 1929. Comparing the 1929 data with that for 1928 the effect of the new boilers on power and steam costs is evident.

The yearly saving due to the new boilers and turbine is estimated as follows:

Difference in cost of steam during 1928 and 1929, based 104,000,000 lb. to manufacturing and heating	$14.560
Yearly repair to keep old boilers in operation	8,000
Difference in cost per kilowatt-hour based on 3,000,000 kw.-hr.	9,000
Saving due to better steam conditions, (195 lb., 125-deg. superheat, instead of 165 lb.)	5,400
Total	$36,960

This figure should improve this year, as no construction will be in progress to cause a disturbance in the efficient operation of the plant.

The total cost of the changes, which were done without any outside engineering supervision except for turbine and boiler erection, amounted to $199,565.98, and was made up of the following details:

Boilers—three 7,370 sq.ft. complete and in operation including foundation, settings, boilers, superheaters, flue, piping, oil burning equipment and instruments	$112,050.09
Moving partition wall	11,000.00
Total	$123,050.09
Cost per sq.ft of boiler surface 5.60	
Turbine, 3,000 kw., complete and in operation	58,503.94
Cost per kilowatt 19.50	
Switchboard and room	15,309.19
Traveling screen for intake water	2,702.76
Total	$199,565.98

For all information *Power* is indebted to Richard Dilworth, plant engineer, who supervised all of the changes, and C. E. Lovering, chief operating engineer.

Tests Show Restriction of Furnace Volume Has Small Effect on Over-All Efficiency

IN A RECENT *Journal of the American Society of Naval Engineers,* the results of a number of boiler tests are reported in an article by Lieut. R. C. Brierly. One series of tests conducted at the Fuel Oil Testing Plant is of particular interest, as it indicates the effect of reducing furnace volume on the boiler efficiency.

The water-tube cross-drum marine boiler tested was made up of five vertical sections of two headers and 400 one-inch tubes each. Immediately below this was the superheater, consisting of four rows of 1¼-in. tubes rolled into superheater headers. The five rows of boiler tubes below the superheater were rolled into horizontal cylindrical boxes. The boiler contained 5,083 sq. ft. of heating surface and a furnace volume of 423.6 cu. ft.

The boiler was fired by five Cuyama oil burners placed in the rear wall. Flame from these burners thus traveled into a contracting furnace volume.

At a combustion rate of 0.981 lb. of oil per square foot of heating surface per hour an equivalent evaporation of 79,631 lb. per hour and an efficiency of 82.71 per cent were attained with the original furnace volume.

The furnace was then bricked up solidly at an angle of approximately 45 deg. in a straight inclined plane from the floor of the furnace to the forward mud drum. This reduced the furnace volume to 302.7 cubic feet.

Tests with the furnace bricked in at a combustion rate of 1.006 lb. of oil per square foot of heating surface resulted in an equivalent evaporation of 81,237 lb. per hour and an efficiency of 82.12 per cent. The B.t.u. liberated per cubic foot per hour at this combustion rate reached the value of 317,179.

A DISCUSSION

By A. L. ROGERS*

Comparing Costs *of* Byproduct *and* Purchased Power

POWER can, in general, be made more cheaply as a byproduct of a steam-using process than by a condensing plant. This fact was illustrated by curves in a paper by J. H. Lawrence and J. A. Frieday presented at a meeting last October of the Pittsburgh section of the A.S.M.E. The abstract of the paper in the December 31 number of *Power* did not touch upon that phase of the paper, which forms the basis of the present discussion by the author.

To make a definite comparison, two typical cases will be established. In the first, the industrial plant will make its own power. In doing so the process steam will be used twice, once for power generation and then for mill purposes. In the second case, the management will purchase power, but all the steam required for manufacturing will be generated in a low-pressure boiler plant.

To make these cases fairly typical of numerous actual factories, the quantity of steam required for process has been set at 140,000 lb. per hour. The required pressure is 50 lb. per square inch. The steam will be dry saturated or only slightly superheated.

These conditions are within the range of present practice for numerous chemical plants, textile mills and specialty factories. The general principles will apply whether the actual quantity and pressure of the steam required are exactly as noted or are at other levels. The power required averages 5,000 kilowatts.

Table 1 shows the principal characteristics of the designs for the two cases. For Case 1 steam is generated at a pressure of 425 lb. per square inch, and at a temperature of 700 deg. F. For Case 2 the steam is made at the pressure required by the factory, namely, 50 pounds.

To produce the required power, the 425 lb. steam is brought from the boilers to the turbines. All steam required for factory use is supplied by extracting from the turbines at the factory pressure.

The total cost for steam and power will vary with the price of coal. To compare cases at several fuel price levels, suitable charts have been prepared. Fig. 1 shows

TABLE I—PLANT DATA

	Generated Power Case 1	Purchased Power Case 2
Number and size of boilers	3 of 800-hp.	3 of 650-hp.
Boiler operating pressure, lb.	425	50
Per cent of rating with all boilers operating	235	252
Per cent of rating with one boiler out	352	378
Total steam output, lb. per hour	158,000	163,000
Boiler plant efficiency, per cent	83	83
Boiler house installation cost	$542,000	$470,000
Number and size of turbines	32,500-kw.	
Output per hour	5,000-kw.	Purchased
Pounds steam per hour for process (supplied by extraction from turbine)	140,000	140,000
Total Installation Cost	$900,000	$470,000

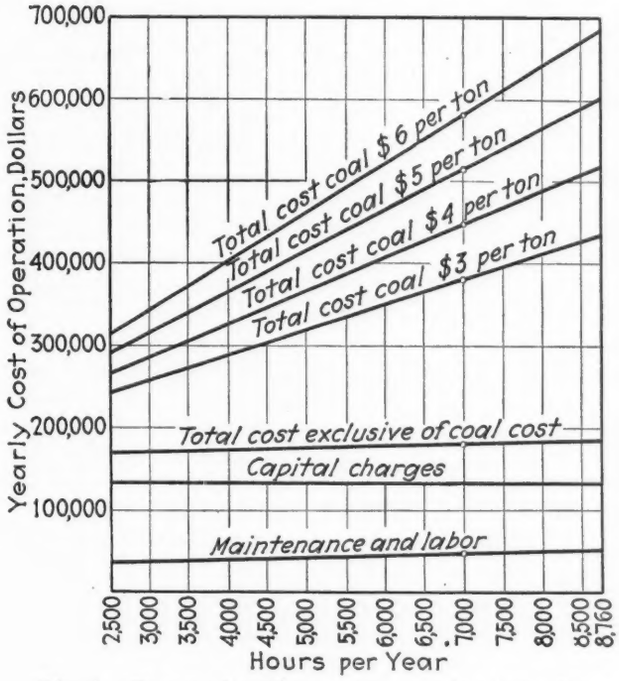


Fig. 1—Curves showing yearly operating costs for Case 1

the effect of varying the cost of fuel on the total cost of steam and power. Fig. 2 shows the effect of fuel cost on the total cost of steam only.

The curve for maintenance and labor at the bottom of Fig. 1 shows only a slight increase with increasing hours of operation. The operating staff will remain on the payroll whether the factory works full time or not. Maintenance costs go up in direct proportion to the amount of coal burned, which varies directly with the number of hours of operation.

Capital charges have been taken at 15 per cent of the first cost. This amount is set aside every year for taxes, insurance, interest, and amortization or sinking fund.

Table II gives a direct comparison for 7,000 hours of operation per year with coal at $5 per ton delivered. In Case 2 the cost of purchased current is one cent per kilowatt-hour. The yearly saving is a net gain to the mill, all capital charges having been paid.

In Table I it is shown that for Case 1 the total output of the boiler plant is 158,000 lb. per hour at 425-lb. pressure. This amount delivers 5,000 kw. of power for

* Industrial engineer, Thomas E. Murray, Inc.

factory use, drives all necessary auxiliaries, and supplies the required 140,000 lb. of steam per hour for process.

In Case 2 the boiler plant output is 163,000 lb. per hour at 50-lb. pressure, or 5,000 lb. more per hour than for Case 1. This larger output of 163,000 lb. per hour drives all necessary auxiliaries and supplies the required 140,000 lb. per hour for process. No power is generated, as all electric current is purchased.

The fact that fewer pounds of steam is required in Case 1, where power is generated, seems paradoxical. However, every pound of steam leaving the boiler plant has a heat content of 1,361 B.t.u., whereas in Case 2 the heat content is 1,178 B.t.u. per pound.

Fig. 4 is the heat-balance diagram for Case 1. Auxiliary drives require about 7 per cent of the total steam output of the boiler. This steam passes through a reducing valve into a desuperheater. The desuperheater lowers the temperature, so that lower-cost auxiliary equipment may be used.

The supply to the turbines averages 145,000 lb. per hour. Of this amount 134,000 lb. will be extracted at 50-lb. pressure. The extracted steam is well superheated. To furnish saturated steam for process the bled steam is desuperheated. The total number of pounds extracted is less than required for process. The warm water pumped to the desuperheater is evaporated, and more than makes good the deficiency. A small margin is left for use in feed-water heating.

The quantity of steam exhausted to the condensers is 11,000 lb. per hour, or less than 7 per cent of the total boiler output. After passing through the condenser and being warmed, the circulating water becomes available as a supply for the boiler-feed make-up and for the desuperheaters. In this manner over 56 per cent of the heat exhausted to the condensers is returned to the system.

The feed-water heater receives the exhaust steam from all auxiliaries as its principal heating element. In addition there is a small supply from the 50-lb. line. Condensate from the condenser and make-up from the circulating water require considerable elevation in temperature to become suitable for boiler feed. Feed water leaving the heater has a temperature of about 202 deg.

A loss of 2,000 lb. of steam per hour is indicated on the diagram. This item is to take care of leakage, safety-valve discharge, soot blowing and blowdown in connection with the boiler efficiency shown in Table 1.

Fig. 3 shows the corresponding heat balance for Case 2. Steam leaves the boiler plant dry saturated at 50-lb. pressure. For process 140,000 lb. is required —this is about 86 per cent of the total output. Auxiliary drives require 19,000 lb. per hour. Steam rates will be high by reason of the small pressure operating range. Since all the heat can be utilized for warming feed water, this is not particularly objectionable. To bring the boiler feed to approximately the same tempera-

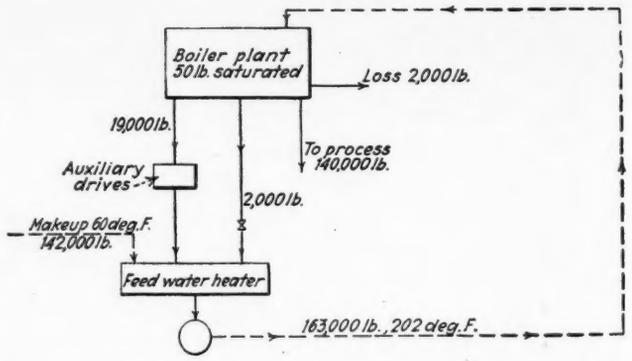


Fig. 3—Heat balance diagram Case 2

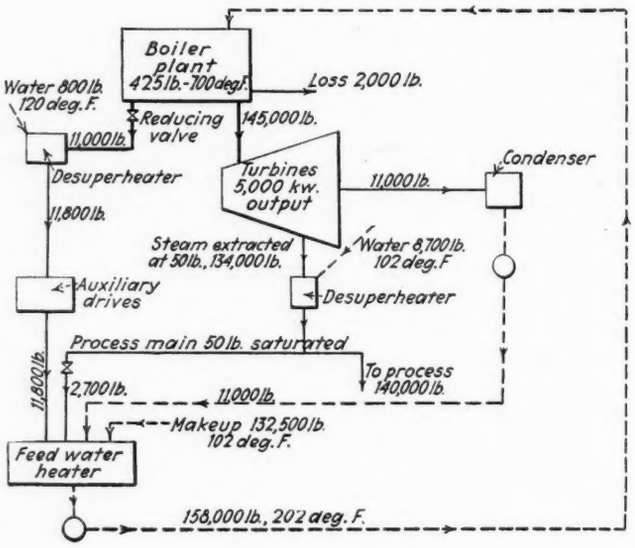


Fig. 4—Heat balance diagram Case 1

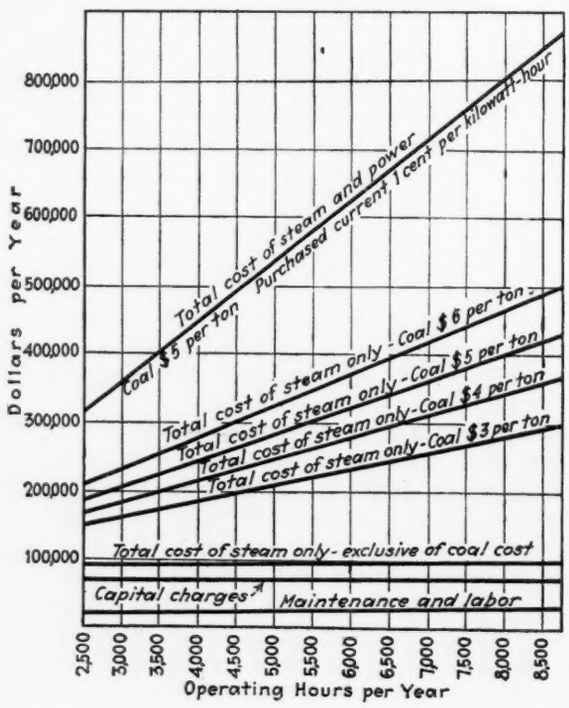


Fig. 2—Curves showing yearly operating costs for Case 2

TABLE II—OPERATING COSTS

	Power generated as by product Case 1	Current Purchased Case 2
Labor and maintenance	$42,600	$27,900
Capital charges (15 per cent of first cost)	135,000	70,500
Total cost exclusive of coal cost	$177,600	$98,400
Coal cost	$304,500	$266,500
Cost of purchased current		$350,000
Total cost of steam and power	$482,100	$616,500
Yearly saving due to by-product power	$134,400	

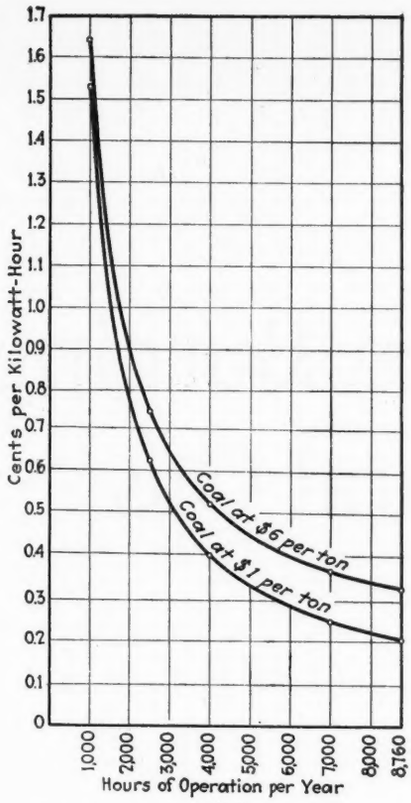


Fig. 5—Curve showing variation of power costs with hours of operation

ture as for Case 1, there has been indicated an additional supply of 2,000 lb. per hour from the boiler to the feedwater heater. The resultant temperature of the boiler feed is about 202 deg.

A comparison of heat quantities is of interest in this connection. For both cases the amount required is 164,920,000 B.t.u. per hour (140,000 lb. of dry saturated steam at 50-lb. pressure). To obtain this for Case 1 the boiler plant burns 17,400 lb. of coal per hour. This weight of coal also produces 5,000 kw. of power.

For Case 2 the fuel consumption is 15,230 lb. per hour, the same amount of heat being supplied to process as for Case 1. The total output of steam holds 192,014,000 B.t.u. The difference goes to auxiliary drives, feedwater heating and miscellaneous losses.

	Lb.
Case 1 Coal burned per hour	17,400
Case 2 Coal burned per hour	15,230
Difference, chargeable to power generation	2,170

$$\frac{2{,}170 \times 13{,}000}{5{,}000} = 5{,}642 \text{ B.t.u. per kilowatt-hour}$$

This is an average, including some condenser loss.

The best up-to-date central stations making power by condensing heat cycles require about 14,000 B.t.u. per kilowatt-hour.

There is another way of showing how extremely cheap power can be made as a byproduct. The following figures are taken from Table II.

Case 1, cost of steam and power	$482,100 per year
Case 2, cost of steam alone	364,900
Difference, chargeable to power	$117,200

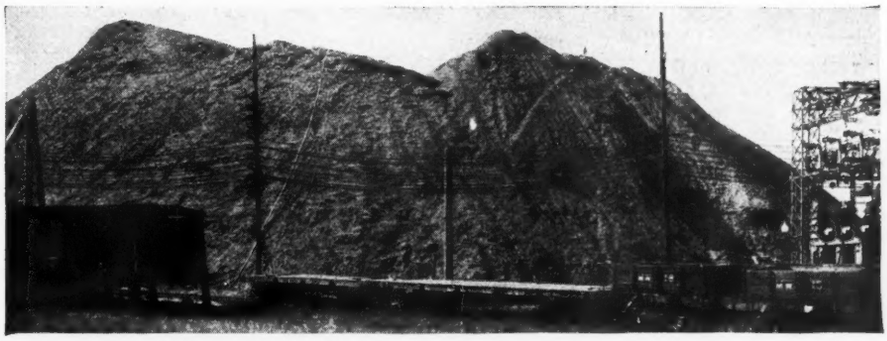
Power generated = 5,000 kw. × 7,000 hr. = 35,000,000 kw. hr.

$$\text{Cost per kw.hr.} — \frac{117{,}200}{35{,}000{,}000} = 0.335 \text{ cents.}$$

In making its own power as a byproduct, this plant would achieve a net cost of less than 3½ mills per kilowatt hour. Fig. 5 shows the effect of hours of operation on power costs. In making a study of this kind for an actual plant it should also be recognized that the character of the process steam load with respect to the power load greatly influences heat-balance conditions.

THE AVERAGE DISTANCE traveled by a kilowatt-hour in the United States between power house and consumer is 22 miles, in spite of our extensive systems of transmission and distribution, and some very long transmission lines, according to the *National Electric Light Association*.

Thirty Million Kw.-Hr. Worth of Sawdust



FUEL STORAGE pile for Station L of the Portland Electric Power Company, of Portland, Ore. This view shows the hogged-fuel pile as of early August, 1929, at which time it contained 40,000 "units" of 200 cu.ft. each. It was more than 120 ft. high (note the man standing on the skyline) and covered four acres of ground. With a conversion factor of about 750 kw.-hr. per unit this pile represents 30,000,000 kw.-hr. of energy.

Determining Air Supply When Burning Natural Gas

Measurement of carbon monoxide, difficult at best, is not a safe indication of the loss due to incomplete combustion when burning natural gas. It has been found that, with this fuel, a CO_2 recorder operating on the density principle will automatically indicate a deficiency of air as well as an excess and that the best efficiency is obtained at the point of highest reading.

By Erik Pick, M. E.*

THE COMBUSTION of natural gas presents problems to the engineer somewhat different from those he has to contend with when using oil or coal as fuel. When burning coal or fuel oil an insufficient air supply is readily recognized by the operator by too high a CO_2 content of the flue gas, as well as, usually, by the appearance of smoke. When burning natural gas, however, these indicators of insufficient air supply are not available, because a reduction of the air supply below the amount required for maximum combustion efficiency does not cause an appreciable rise in CO_2 content, nor is smoke always produced. Yet means to detect a deficiency in air supply must be made available to enable the operator to avoid this condition and prevent the serious heat losses resulting from it.

The usual suggestion is that CO be determined in addition to CO_2 to detect a deficiency in air supply. However, when burning natural gas with a deficiency in air supply the flue gas contains, in addition to carbon monoxide, hydrogen, methane and other hydrocarbons, the CO percentage frequently being quite low. This is confirmed by A. C. McHugh's statement[1]: "The CO_2 was approximately 8 per cent, there was a trace of CO present, and the efficiency was far below that expected."

The presence of 1 per cent of CO in the products of combustion of natural gas causes a heat loss due to incomplete combustion amounting to about 3 per cent. A mere trace of CO alone can never be responsible for a decided drop in boiler efficiency. The low efficiency, therefore, must have been due to the unsuspected and undetected presence of hydrogen and hydrocarbons in the products of combustion. While the heat loss due to 1 per cent of CO or H_2 is approximately 3 per cent, that due to 1 per cent of CH_4 is in the neighborhood of 9 per cent. Therefore, if 1 per cent of CO is accompanied by equal amounts of H_2 and CH_4, the total heat loss due to complete combustion amounts to approximately 15 per cent. Since, as stated above, the amount of CO may be very low, while appreciable quantities of other unburned

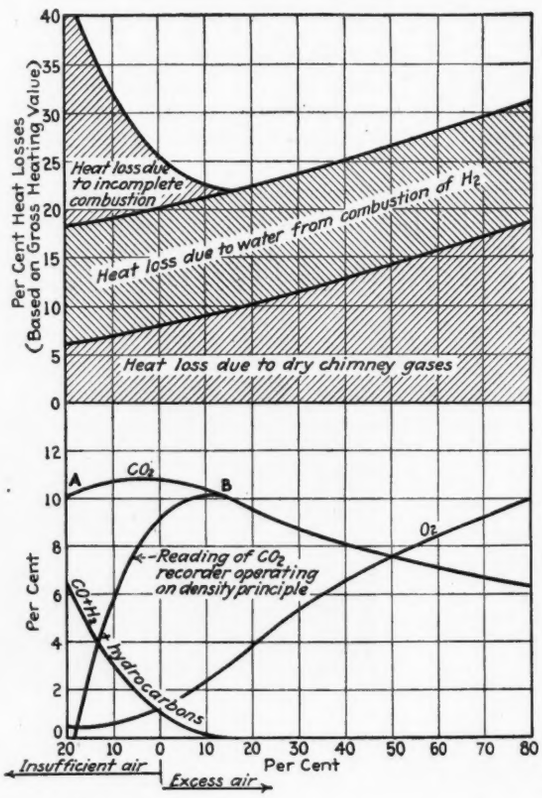


Fig. 1—Flue-gas analysis and heat losses of a natural-gas-fired boiler

*The Permutit Company.
[1]*Power* June 18, 1929.

gases go up the stack, the trace of CO as well as immense heat losses might easily escape the operators' attention, even if the CO as well as the CO_2 content of the flue gases were known.

Determination by chemical methods of hydrogen and hydrocarbons in the products of combustion requires rather complicated apparatus not suitable for use as a continuous guide for regulating the air supply. It will therefore be of interest to those dealing with the combustion of natural gas to know that the gas-density type of CO_2 recorder indicates, in a single operation, an excess as well as a deficiency in air supply.

The design of this instrument is based on the fact that the specific weight of flue gas increases in proportion to its CO_2 content. If the combustion is incomplete and hydrogen and methane, both lighter than air, are present, the density of the flue gases is reduced to such an extent that the recorder gives a low reading and may even have a tendency to indicate negative values. When burning natural gas, the specific gravity of flue gas is increased by approximately 0.3 per cent for each per cent of CO_2. On the other hand, 1 per cent of H_2 reduces the specific weight of this flue gas by about 0.9 per cent and therefore lowers the reading by about 3 per cent CO_2. One per cent CH_4 lowers the gas density by about 0.45 per cent, and thus compensates for approximately 1.5 per cent CO_2. Carbon monoxide, having the same specific gravity as nitrogen, does not perceptibly change the density of the flue gases, and, consequently, has no effect on the reading.

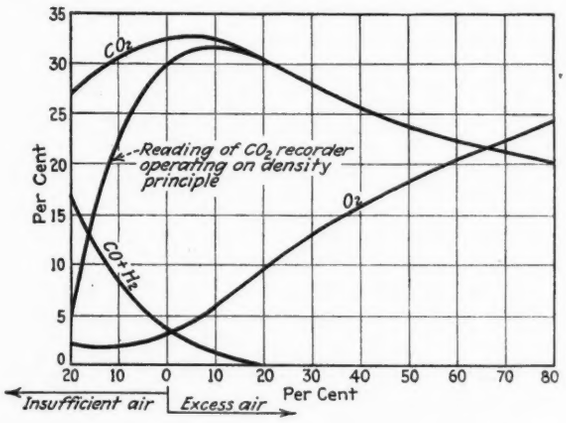


Fig. 2—Exhaust-gas analysis of a gasoline engine

In Fig. 1, based on actual field tests, the conditions illustrated are such as take place when natural gas consisting chiefly of methane is used as fuel. The lower part of this diagram shows the flue-gas analysis and the reading of the recorder. In the upper part of the diagram the stack losses have been plotted, the total stack loss consisting of the heat loss due to the heat content of the dry flue gases, the loss due to water formed by combustion of the hydrogen, and that due to incomplete combustion.

It can be seen from this diagram that the minimum total stack loss, corresponding to maximum boiler efficiency, just about coincides with the maximum reading of the recorder. To prevent the avoidable heat losses due to too much or too little air, all the operator has to do is regulate the air supply so as to give the highest possible CO_2 reading. Since there is no time required for chemical reactions and since the fan of the mechanical recorder draws the gas sample through the pipe line at a high rate of flow, the time lag is short and the operator has no difficulty in quickly adjusting the air supply to the correct value by using the recorder as a guide.

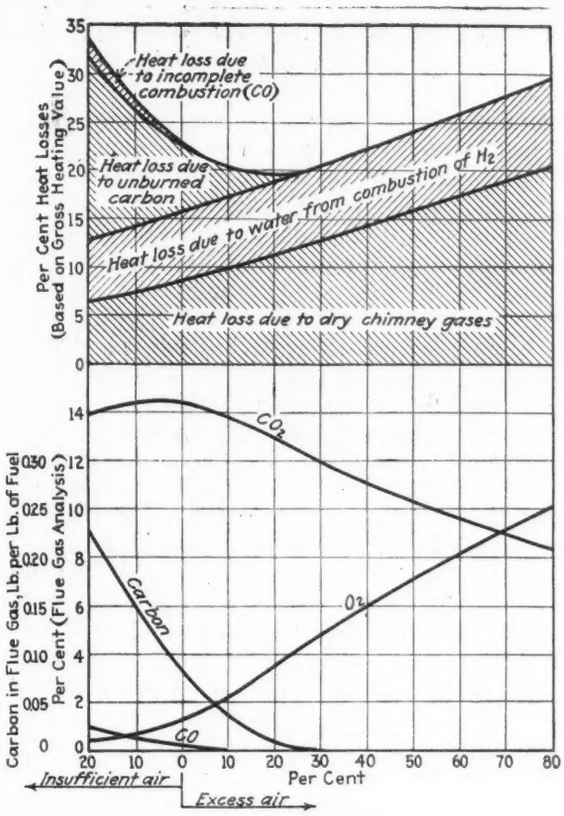

Heat loss due to incomplete combustion (CO)
Heat loss due to unburned carbon
Heat loss due to water from combustion of H₂
Heat loss due to dry chimney gases
Per Cent Heat Losses (Based on Gross Heating Value)
CO₂
Carbon
O₂
CO
Carbon in Flue Gas, Lb. per Lb. of Fuel
Per Cent (Flue Gas Analysis)
Insufficient air
Excess air
Per Cent

Fig. 3—Flue-gas analysis and heat losses of an oil-fired boiler

In the plant of a southern public utility corporation 10,800-sq.ft. natural-gas-fired boilers were equipped with recorders of the gas-density type. During the first days of operation it was found that their reading dropped at times as low as zero. At first the machines were thought to be at fault, but further investigation revealed that the drop occurred during periods of high load when the air supply was insufficient. Thereafter it was an easy matter to prevent the recurrence of operation with insufficient air for any appreciable length of time.

It is interesting that a large discrepancy in CO_2 reading between this type of CO_2 recorder and the Orsat becomes, when properly interpreted, a valuable feature, since it eliminates the necessity of providing separate, additional means for determining the presence of unburned or incompletely burned gases.

Fig. 2 shows, for varying excess air, the analysis of the exhaust gases of an internal-combustion engine using gasoline as fuel. The similarity of the analyses shown in Figs. 1 and 2 is obvious. It should be noted, however, that in this case the percentage of CO and H_2 is somewhat higher than in the case of natural gas, and there are only traces of hydrocarbons present. Thus gasoline, consisting of light hydrocarbons, shows a similar behavior to that of natural gas whose chief component is methane.

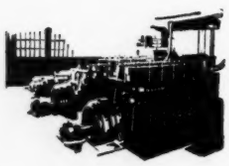
The heavy fuel oil ordinarily used in boilers, however, does not fall into this class, but burns in a manner similar to coal, which, when insufficient air is supplied, produces a flue gas containing unburned matter only as CO and soot (smoke) in appreciable quantities. The conditions existing in an oil-fired boiler of 6,750 sq.ft., with steam atomization, are illustrated in Fig. 3. As can be seen

from this diagram, the CO content cannot be used as an indicator for the losses due to incomplete combustion, because the loss due to unburned carbon far exceeds the CO loss, and large amounts of unburned carbon appear even before any CO is formed. At less than the theoretically required amount of air (zero per cent excess) the CO_2 content falls off. But under these conditions the draft was so low that smoke and even flames came out of openings in the furnace and thus clearly indicated a deficiency in air supply, which was further evidenced by dense black smoke issuing from the stack. In such a case the operator can never be in doubt whether a low CO_2 reading means too much or too little air.

In this test the stack loss was found to be lowest and the efficiency highest with about 20 per cent excess air, corresponding to a CO_2 content of about 13 per cent. At the same time the flue gases leaving the stack had a light yellow color and were barely visible. The amounts of hydrogen and hydrocarbons in the flue gas were exceedingly small throughout the range covered by the test. Therefore, with oil (as well as coal) as fuel a CO_2 recorder based on the density principle indicates the true CO_2 content even with a deficiency in air supply, and this deficiency can be recognized by too high a CO_2 content and, usually, the appearance of smoke.

Operating Costs of a Diesel Municipal Plant

By J. H. Bender
City Manager, Duncan, Okla.



DUNCAN, OKLA., generates power for less than one cent per kilowatt-hour in its Diesel-electric station, which has an installed capacity of 2,150 hp., or 1,460 kw. at 80 per cent power factor generator rating. This capacity is made up of four units as follows: One 365-hp. Busch Sulzer unit, installed 1921; one 520-hp. Busch Sulzer unit, installed 1921; one 665-hp. De LaVergne unit, installed in 1925; and a 600-hp. Busch Sulzer unit, installed in 1929.

Conditions surrounding the operation of the plant are unusual, as it is one of the few municipal stations operating in competition with a large public utility. Naturally, the rivalry is keen, and to justify its existence the municipal plant must produce energy at a reasonable cost to sell it competitively.

A brief summary of the operation and maintenance costs in the Duncan plant for the past two fiscal years is given in the tabulation.

DIESEL-ELECTRIC PLANT OPERATION

	Fiscal Year Ending June 30, 1928	Fiscal Year Ending June 30, 1929
Total output, kw.-hr.	2,096,300	2,146,650
Peak load on plant, kw	840	680
Plant load factor, per cent	26.5	27.1
Load factor on units, per cent	68.1	67.7
Total fuel oil used, gal.	198,618	208,210
Kilowatt-hours per gal. of fuel	10.55	10.31
Lubricating oil used, gal.	2,204	2,614
Salaries, chief eng. and operators, per kw.-hr., mills	3.23	3.38
Maintenance:		
Buildings, grounds and electrical equipment	0.038	0.116
Engines and auxiliaries	0.791	1.112
Fuel oil	3.756	3.339
Lubricating oil	0.579	
Miscellaneous, including extra labor, property and liability insurance and portion of city clerk and city manager office expenses	1.10	1.00
Total cost, mills per kw.-hr.	9.497	9.827

The explanation of the rather heavy lubricating oil consumption is that no lubricating oil reclaimer or centrifuge is used. Units are run from 1,000 to 1,200 hr., then drained and new oil added. Oil from the engines is heated to settle out heavier impurities and is then used for pumping machinery, street-building equipment and in other municipal departments where a good quality clean oil is not essential. An oil-reconditioning system is being installed, with anticipated savings of at least 40 per cent. In the past, the electric plant has been given no credit for the used lubricating oil given to other municipal departments.

In an analysis of the operation and maintenance costs it should be borne in mind that two of the Diesels are operating in their seventh and eighth years and the third Diesel in its third and fourth years. The fourth Diesel was not placed in service until after the period covered by these reports. Because of competitive conditions, the Duncan plant cannot afford to take chances on service interruptions, and maintenance cannot be neglected. In the two-year period covered by this report there was but one service interruption; this was of some ten minutes' duration, caused by the shearing of a small pin in the overspeed governor of one engine while it was carrying the entire plant load. Service was interrupted only until another engine could be started.

Duncan is favorably situated in the Southern Oklahoma oil fields, where good Diesel fuel can usually be secured at a reasonable price. Fuels as heavy as 24 to 26 Baumé gravity are sometimes used, but the normal fuel is a 32 to 34 Baumé gas oil. It is quite probable that the excellent quality of fuel has played an important part in the service record and the freedom from excessive maintenance in the plant, as has also the ability of the chief engineer, W. O. Abrams, and his operating engineers.

Except for one cylinder damaged by accident, neither of the two engines installed in 1921 has had a new cylinder liner or has had an old liner rebored. The maximum wear in the old cylinders at the time of the last general overhauling, early in 1929, was 0.043 in. Unless damaged by unforseen accident there should be three or four years' more service in the original cylinders and pistons. No main shaft bearings, crank bearings or wristpin bearings have ever been replaced, and all crankpins are within 0.003 in. of true.

The items of expense for maintenance are misleading, in that it consistently has been the policy to keep on hand a liberal stock of spare parts for all equipment, which stock is being increased year by year. Each invoice of parts is charged at the time of purchase to maintenance, regardless of whether the part is put into use or placed in stock, and no credit is given the maintenance account for inventory value of the stock of parts at the end of the fiscal year.

Each engine is given a careful inspection and overhauling early every year, and maintenance work is done at that time. Except for the routine work of valve grinding and adjustments of a minor nature, little repairs of consequence are required between these annual overhaulings. Continuous runs of 30 or 40 days for individual units are not uncommon, but the usual operating schedules seldom require any unit to be on the line longer than two weeks.

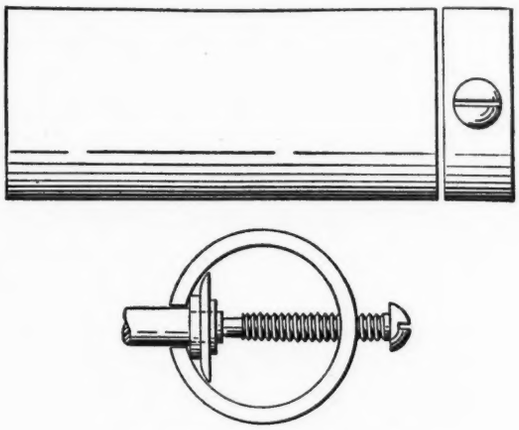
Right Out of the Plant

Hub Puller for Pressure-Recording Gages

IT OCCASIONALLY happens that the chart-turning hubs on pressure-recording gages are forced on to the driving shafts so tightly that they are hard to remove when it becomes necessary to get the clock case covers off to clean and oil the mechanism.

A small puller for doing this, as well as many other small jobs that come up around the shop, can be made from a piece of 1-in. pipe and a small machine screw.

In constructing the puller, a short piece of pipe is first drilled and tapped for a $\frac{3}{16}$-in. machine screw at a point



Hub puller made from pipe

about $\frac{1}{4}$ in. from the end. A ring section $\frac{1}{2}$ in. wide is then sawed and slotted opposite the screw to permit the ring to be slipped over the shaft behind the hub. In use, the ring is put in place and the screw tightened until the hub is forced off.

Sizes for heavier work may be easily made by using larger and heavier pipe or tubing.

Who Is to Blame?

THERE is an old saying that ignorance is bliss, and with some engineers I have met it seems to be a fixed asset. The average engineer who has a modern plant thinks that all plants must be like his. But there is a big surprise awaiting him if he takes a trip and visits a few industrial plants outside of his own town. Just how some engineers "get by" has always been a mystery to me.

I can recall a few plants where I installed boiler room equipment that were up to date in every respect, except they were still using the old method of hand firing. They had fine engine rooms, uniflow engines and recording meters, steam-flow meters, in fact, everything to make a modern plant, except stokers. From my knowledge of boiler room operation and from a study of the operating records in these plants, it was very apparent that installation of a modern stoker would have paid for itself in a short time, yet these plants have been running in this condition for several years.

I have also encountered fairly large plants still operating hand-fired horizontal-return-tubular boilers fitted with dutch ovens, where installation of one of the modern stokers now available would cut the fuel consumption at least 50 per cent and give considerable reserve boiler capacity.

Of course, the engineer is not always to blame for the poor conditions existing in some plants, as it is not always possible to get the necessary appropriation. However, if all engineers were alive to the possibilities for substantial savings through modernization of their plants, there would not be so many changed over to purchased power.

G. JACOBS.

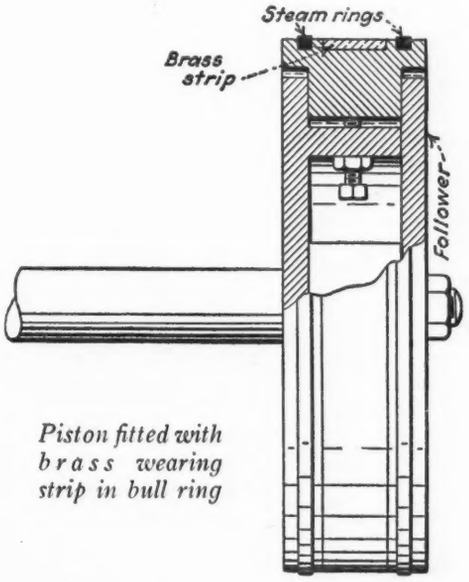
Flint, Mich.

How the Wear on the Piston Was Reduced

IN VIEW of the discussion that has taken place on the subject of wearing of steam pistons and the use of steel for rings, the following account of an experience with a 29 x 30-in. high-speed side-crank steam engine might be of interest.

The engine had given satisfactory service for several years, but about five years ago the superheat was increased about 50 deg., after which the bull ring began to wear down. As the ring had three positions, we shifted it from one to the other until it was worn on all positions. Then we ordered a new one from the engine manufacturer. The new ring did not wear any better than the old one.

After trying all kinds of cylinder oils to no purpose, we decided that the ring was not wide enough to resist wear. To increase the width we had a pattern made



Piston fitted with brass wearing strip in bull ring

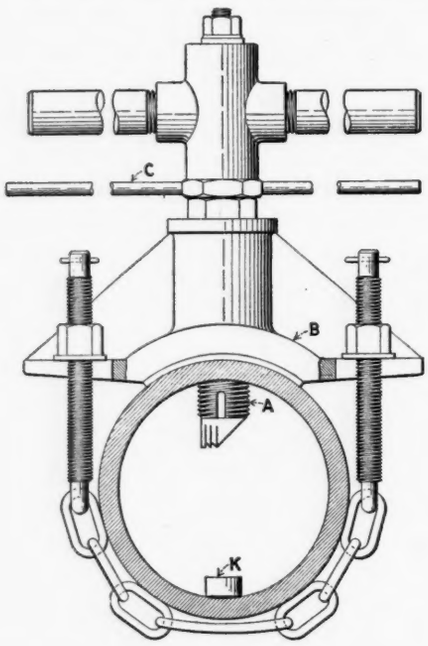
3½ in. wider than the one in use. We then turned down the back flange of the piston and the follower 3½ in. in diameter so the bull ring would extend over them as shown in the illustration. The steam rings were placed as far apart as possible and a recess was cut in the space between them. A brass ring was then made to fill the recess and riveted to the cast-iron bull ring. With this ring we have had no further trouble.

Mechanicsville, N. Y. GEORGE W. CLARKE.

Practical Device for Making Connections to Pipe Under Pressure

THE ACCOMPANYING illustrations show a method of tapping and making connections to mains carrying water, gas, oil or steam under pressure. Fig. 1 shows the attachment assembled ready for drilling the pipe and tapping it and also the operation completed with the sleeve *A* screwed through the pipe. *A* is a 1-in. sleeve of non-corrodible mild steel, suitably shaped and case-hardened on the end to form a cutter and tap. *B* is a saddle fixed to the main with chain and hook bolts, with the chain having the proper length to suit the size of the main.

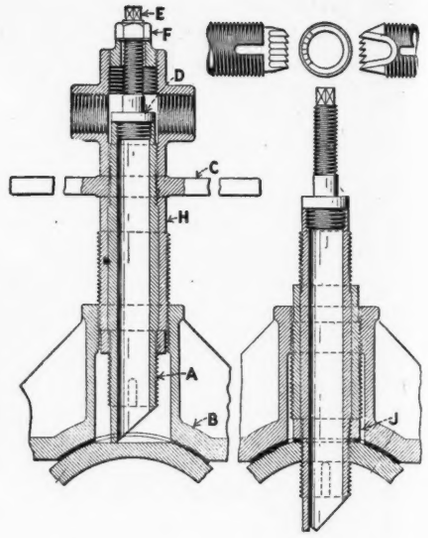
The screwed sleeve *A*, by means of which the cutting



Device is held in place by saddle with chains around the pipe

and tapping is done, is fed in by means of the hexagonal part with a light spanner. The sleeve is rotated by the double handle *C*. *D* is a plug closing the upper end of the sleeve until the service and service cocks have been attached to the branch. When service cocks are attached plug *D* is unscrewed from the sleeve in the upper part of the tee by means of the square *E* and locked by the nut *F*.

The saddle is removed from the pipe in either of two ways. First by making it in halves and bolting it together and registering the halves with dowel pins, or the plug can be left in position in the end of the sleeve and the parts tee *G*, handle *C* and sleeve *H* unscrewed from the sleeve *A*. When this has been done the saddle *B* can be slipped off over the sleeve. With the saddle removed the tee is screwed into place again and the connections made to it. Then the plug *D* is screwed out



Section of device ready for tapping and partly dismounted

and the branch is ready for service. The sleeve *A* is made fast in the pipe and a tight joint secured by the nut *J* and the gasket, as shown.

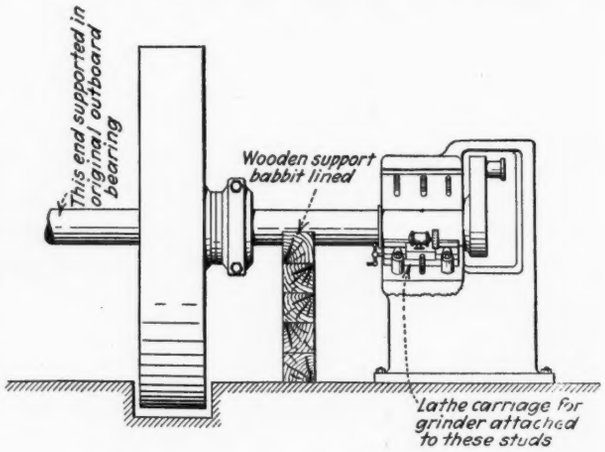
It will be seen that the cutting end of the sleeve *A* is on an angle. This is done to permit the piece cut out, as at *K*, to drop to the bottom of the pipe and not block the opening through the sleeve.

How the Engine Crankpin and Shaft Were Trued Up

SOME time ago I installed power plant equipment at the Florida State Hospital, Chattahoochee, Fla. This institution had under way the installation of a used 24 x 18 four-valve engine direct connected to 200-kw., 2,300-volt, generator.

This unit had been purchased at a reasonable price and mainly on the strength of its having recently been converted into a modern type uniflow. A new uniflow cylinder had been attached to the old engine bed after the old cylinder had been wrecked. Although some information of the smash up had been gathered by the purchasers, the true history of the engine and the exact cause of the wreck were unknown to them.

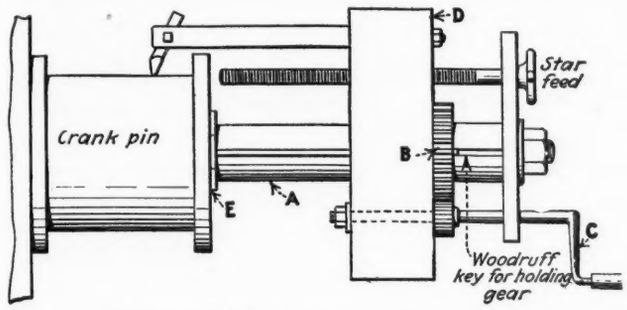
The engine bed was of an old design, being fitted with a two-piece main bearing, the bottom half babbitted in the frame and the top cap held in place by six 1½-in.


This end supported in original outboard bearing
Wooden support babbit lined
Lathe carriage for grinder attached to these studs

Grinder in place for work on crankshaft

stud bolts which allowed the full thrust on the head end stroke to be delivered directly against these stud bolts.

It was found that the crank disk was out of true about $\frac{1}{8}$ in. at the rim, and the cast rib which held the main bearing cap in position at the bottom was broken. When the engine was put into operation there appeared to be undue strain on the main bearing stud bolts and considerable time was spent in checking at different points where trouble could be expected, such as alignment of crankshaft, and connecting rod. It was found that the connecting rod had a lateral movement of 5/16 in. on the pin when turning the engine to different points



Machine used to true up the crankpin

of the stroke. On close check with a sensitive level, the crankpin proved to be out of parallel with the crankshaft about 1/64 inch.

As there was no machine available for truing up the crankpin some means of doing it on the job had to be devised. I supervised the construction of a machine to do this work. Fig. 2 gives an idea of how it was made. The sleeve *A* and the gear *B* are stationary, and the crank *C* with pinion attached extends through block *D* and revolves around gear *B*. Shims were used at the point *E* to offset the machine the amount the pin was cocked.

There was considerable doubt as to the crankshaft being straight close to the crank disk, as in calipering it showed a taper and flatness, so when truing up the crankpin a point near the flywheel was taken where the shaft was round.

After operating the engine again it was soon discovered that all troubles had not been overcome, and the next process was to procure an indicating surface gage and check for a sprung crankshaft. While waiting for the gage we removed the piston, crosshead, connecting rod, etc., and ran a line through cylinder tramming at all points in cylinder and guides. The engine was found to be dead in line. When testing with the surface gage the crankshaft was found to run out 0.012 inch.

The crankshaft was jacked out of the main bearing and placed in the temporary bearing, as shown in the illustration, and the outboard bearing was also raised to bring it to a level position. In that position the shaft proved to be out as much as 0.021 in. near the crank disk. Thus we were faced with the problem of truing up the shaft without removing the governor wheel, stator, etc., and shipping it to a machine shop, which was considered too expensive and would require too much time.

It was decided to true up the shaft in its place. The machinists fitted a tool post and carriage long enough to travel the full width of the main bearing. This was bolted to the main bearing as shown. An old gas engine was used as a countershaft for speed reduction and a 1,200 r.p.m. motor for the drive. The motor was belted to the gas engine and the gas engine to the flywheel on the shaft, giving a final speed of 38 r.p.m.

The improvised tool post and carriage were considered too weak for a cutting tool and a high-speed grinder was used instead. The shaft was ground until the 0.021 in. throw was taken out. When the engine was assembled it gave no further trouble. J. L. Davis.

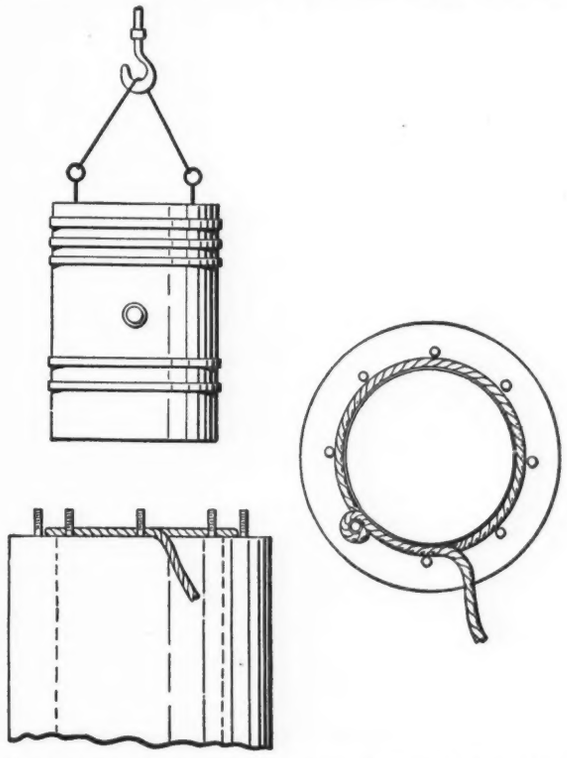
Chattahoochee, Fla.

Replacing Pistons in Diesel Engines

IN THE Dec. 17, 1929, number of *Power* there was a description of tools for compressing rings when replacing Diesel pistons in the cylinder. The method of doing this work described in the letter would appear to be more difficult than the one I used while replacing the pistons in two vertical Diesel engines.

The piston to be replaced was raised with the crane by two eyebolts and a sling, as shown; oiled, lowered, and entered into the cylnder until the first bottom ring was within 1/16 in. of touching the face of the cylinder.

A piece of sash cord with a smooth finish was then loosely tied to a cylinder head stud and passed around the piston and ring in a counter-clockwise direction. A strain was then taken on the cord until the ring was compressed into the piston groove and the piston was carefully lowered into the cylinder an amount equal to about half the width of the ring, which would slip down through the cord. The cord was then slackened and moved out against the studs, the piston lowered again until the next ring was about to touch the cylinder. The cord was again drawn around the ring until it was compressed; the piston was lowered as before until the ring had entered about half its width. This was repeated for each



Method of using sash cord to compress piston rings

ring, until they all were entered into the cylinder, care being taken to see that the connecting rod was in proper position to go onto the crankpin bearing. With a little care it required only a few minutes to lower a piston into its place.

Somerset, Mass. William H. Burton.

FROM AMONG READERS' PROBLEMS

Conducted by L. H. MORRISON

HORSEPOWER OF PUMP—*What is meant by the horsepower of a pump?* H.P.R.

Five different values of horsepower of a pump must be distinguished: (1) The indicated horsepower of the steam end, obtained from indicator diagrams of the steam end in the same way as determining the indicated power of a reciprocating engine; (2) the brake horsepower, or power actually transmitted to the pump, and which in a direct-acting steam pump would consist of the indicated power of the steam end less the friction of parts essential to operation of the steam end; (3) the indicated horsepower of the water end, obtained from indicator diagrams taken from the water cylinder to determine the power transmitted by the water piston or plunger; (4) the water, or developed, horsepower to express the useful work done by the pump, based on the actual weight of water discharged and total height through which the water is elevated; (5) what is commonly recognized as the nominal horsepower, which is based on the weight of water that would be displaced per minute by the plunger or piston if there were no slippage, combined with the discharge pressure plus the lift measured from the water level in the suction well to the height of the discharge gage.

Thus, if the plunger or piston displacement is 1,000 gal. per minute, it would be assumed that the pump actually handled 1,000 $\times$ 8⅓ = 8,333 lb. of water per minute; and if the discharge pressure indicated 40 lb. per square inch and the height of the gage was 16 ft. above the water level of the suction gage, the total lift would be considered as equivalent to (40 lb. $\times$ 2.3 ft. per lb.) + 16 ft. = 108 ft., making 8,333 $\times$ 108 $\div$ 33,000 = 27.27 nominal pump horsepower.

SETTING SLIDE VALVE WITH LEAD—*What is the method of setting the valves of an upright slide-valve engine and how much lead should there be?* D.M.

The method is practically the same as for setting the valve of a horizontal slide-valve engine. Remove the steam chest cover and, with the eccentric fast on the shaft, turn the engine over by hand and find whether the admission edge of the valve overrides the admission edge of the steam port as much for one of the cylinders as for the other. If the amounts are not the same, they should be equalized by adjustment of length of the valve rod. Then place the engine on a center and set the eccentric to such a position that the valve will give the desired lead opening at the beginning of the stroke, but with the eccentric so placed with reference to the crank that the opening will be increased by turning the engine in the running direction.

Next, place the engine on the opposite center, and if the lead is not the same, obtain one-half the desired lead by readjustment of the valve rod and one-half by readjustment of the eccentric, repeating these adjustments on one end and then the other until the lead is equalized.

The appropriate amount of lead opening depends on size, design and speed of the engine, and also on steam pressure and load to be carried. The lead should be at least enough to obtain full steam-chest pressure in the cylinder at the beginning of the stroke when the engine is running at normal speed, and also as much as may be necessary, in conjunction with compression of the exhaust, to insure sufficient cushioning of the piston for quiet running of the engine.

PRESSURE IN AIR COMPRESSOR—*When an air compressor is working is the pressure within the cylinder greater than in the air receiver?* C.C.

Yes. The pressure in the cylinder must be enough greater than that in the receiver to overcome the discharge valve resistance and the frictional losses in the pipe to the receiver.

CUSHIONING ON EXHAUST OF DUPLEX PUMP—*What prevents a duplex steam pump from striking at the ends of the stroke?* W.R.

The passage for the escape of exhaust steam from the cylinder is covered by the piston before completion of the stroke, and exhaust steam then remaining in the end of the cylinder and steam passage is compressed by further movement of the piston and acts like a cushion in bringing the piston to rest before it strikes the end of the cylinder.

PREVIOUS QUESTION

DISCUSSED BY READERS

THE QUESTION

WHEN using a magneto to make ground and open-circuit tests sometimes the indications obtained are the opposite from what they should be. What is the reason for this? C.M.

ALTERNATING CURRENT is the output of a magneto used as the ringer in a test set. At the average speed of turning the crank about 100 volts is produced. The ringer coils have a high resistance, usually 2,500 to 5,000 ohms, so that a small current causes the bell to ring.

Two well-known alternating-current principles are: A coil of wire retards the flow of current through self-induction; and, two conducting bodies placed near each other will, due to their electrostatic capacity, permit a flow of current in the circuit.

The shunt-field coils of a motor consist of a large number of turns of wire, consequently they have high self-induction. The conductors in a lead-covered cable have electrostatic capacity depending upon their length, distance apart, and the insulation between.

From the foregoing it is evident that open-circuit indications might be obtained when testing a coil of many turns with a magneto; and evidence of ground or short-circuit faults might be obtained on long conductors, even when the equipment is in good condition. At best an alternating current magneto is a crude and unreliable form of test instrument. This does not apply to the direct-current magneto, where the indications are given by a sensitive millivoltmeter.

R. H. PICKENS.

Clemmons, N. C.

The question shows the necessity of caution when applying one of these devices. When making tests for the continuity of circuits that have high inductance the magneto is likely not to give any indication even when the circuit is complete. On the other hand, equipment that has considerable electrostatic capacity, such as long lead-covered cables or large machines, may show short circuits and grounds if tested with a magneto when no fault exists. This may surprise some operators who have been depending upon magnetos to show the conditions of electrical equipment.

It is the practice of some operators to make approximate insulation resistance tests with a magneto. An instrument that will ring through 40,000 or 50,000 ohms is used. If the magneto does not ring when connected between the conductors and ground the insulation is assumed to be satisfactory. If such a test is made on a large machine the electrostatic capacity of the winding may be sufficient to allow a current to flow that will ring the magneto, no matter how high the insulation resistance may be.

A magneto may be relied upon to give fairly accurate results on circuits that have low inductance, such as used for bells and lighting and when testing for grounds on small armatures. Outside of such applications its use should be governed with caution.

There are many testing devices on the market, but when testing circuits for continuity, a simple buzzer and dry cell have many advantages. A permanent-magnet type voltmeter and direct-current circuit may be used to test insulation resistances. There are a number of devices available that read insulation resistance directly and are being used extensively.

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IF THE circuit is complete and within the resistance through which the magneto is designed to operate, the bell should ring. Failure of the bell to ring indicates that the circuit is open, or a resistance too great to pass enough current to ring the bell. A magneto is a small alternating-current generator. In the case of the shunt winding of a motor both the resistance and the inductance are high, therefore the circuit has sufficient impedance to prevent the bell's ringing.

A magneto should not be used for an insulation test between the frame and armature of a large machine, between coils and the core of a large transformer, between the lead sheath and the conductors of a long cable, or any other circuit of considerable electrostatic capacity. Such a circuit may act as a condenser, receiving current enough to cause the bell to ring, indicating a circuit between the terminals of the magneto even though the insulation is in good condition.

F. A. WILSON,
Gulf States Utilities Company
Beaumont, Texas

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A MAGNETO of the type used for ringing out circuits produces alternating current. Therefore, reactance as well as ohmic resistance restricts the flow of current in the circuit being tested. There may be sufficient impedance in a field coil to prevent the bell ringing even though there is no open circuit.

The presence of iron increases the reactance, and therefore the impedance, of a circuit, and the magneto might have rung through the coil had it been removed from the polepiece. On the other hand, it is possible to obtain a ring on some electrical apparatus between the winding and the frame when no ground exists. This is because of the electrostatic capacity between the conductors allowing sufficient current to flow to ring the bell. A megger or a direct-current and a voltmeter should be used for this type of testing, as they indicate ohmic resistance only.

A. L. COOPER, *Engineer,*
Holly Sugar Corporation
Colorado Springs, Colo.

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WRONG INDICATIONS when testing with a magneto may be expected when checking circuits having certain characteristics. A magneto generates an alternating current. When this current is put through a coil on an iron core, such as the field coils of a direct-current generator or motor, their inductance will keep the current down to a value where it will not ring the bell.

A Question for Our Readers

WE HAVE three two-wire direct-current compound-wound steam-engine driven generators that are connected for parallel operation on a three-wire system. The neutral of the three-wire system is obtained from a balancer motor-generator set. The three two-wire generators are rated 600, 400 *and* 200 *kw., respectively. During heavy load periods the* 600- *and* 400-*kw. units are operated in parallel. Recently the* 600-*kw. machine has developed a tendency to hog the load from the* 400-*kw. unit. What might be the cause? Until this trouble started the machines operated satisfactorily in parallel.* F. C. B.

Suitable answers from readers will be paid for and published in the March 18 number.

This action is shown in an unloaded transformer where a small current flows in the primary.

On a test where the equipment has high insulation resistance, but has considerable conductor surface in parallel, a condenser is formed. When such a circuit is connected to a source of alternating current, a current will flow through the leads and will cause the bell to ring. This action is indicated in the radio condenser, where high-frequency currents flow without a complete metallic circuit. The magneto tester is reliable only on circuits such as used in house wiring.

St. Louis, Mo. A. L. FREULER.

REGARDING the use of magnetos, I should like to quote from the "American Electricians' Library," by Terrell Croft, "Circuit Troubles and Testing," in which is the following statement:

"If a long line is rung out with a magneto ringer, the bell may ring, thus indicating a short circuit when actually none exists. The reason for this false indication is that the long line has a high capacitance (considerable electrostatic capacity) and the alternating current which flows through the magneto in alternately charging the two conductors to positive and negative potentials is sufficient to ring the bell. In other words, the two long conductors, which constitute the line, form a condenser, and an alternating current will "flow through" a condenser.

"In attempting to ring out a coil which has a high inductance, such as the shunt-field coil of a direct-current motor or generator, it may be found that the bell will not ring, thus indicating an open circuit. But the circuit may not be open. The bell does not ring, even when the circuit is closed, because the high impedance of the inductive winding to alternating current does not permit sufficient current to flow through the magneto to ring the bell."

A 10,000-kw. generator had its armature winding broken down to ground by lighting troubles. Indications obtained with a magneto were that the field leads were grounded, yet a reading of 50 megohms to ground was secured with a megger. Similar results have also been obtained on some of our long feeder lines in station service.

CHESTER L. COOK,
Steam-Plant Electrician,
Pennsylvania Water & Power Co.
Holtwood, Pa.

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THE QUESTIONER no doubt understands Ohm's law, but has not applied it properly to the magneto, which generates alternating-current. On an alternating-current circuit Ohm's Law is *amperes equal volts divided by ohms impedance,* in which the impedance depends upon resistance, electrostatic capacity, inductance, and frequency.

A pair of insulated wires close together has high electrostatic capacity. This accounts for the magneto's ringing when there is no fault in the circuit. A closed circuit is not necessary to the flow of alternating current. For testing of insulation on long cables, voltmeters and galvanometers are used in a number of different methods outlined in any electrical-engineer's handbook.

In the case of the field winding test, the inductance of the circuit is so high that it prevents ringing of the magneto bell, thus giving a false test. A direct-current source should be used instead of a magneto. If no other direct current is available, use a few dry cells and a bell.

WILLIAM LINDLAR,
Instructor in Physics,
Erasmus Hall High School.
Brooklyn, N. Y.

HAMS HALL... First English Station Designed for Pulverized Coal

Design of this key station in Central England reflects American power plant practice in many details. The article is an abstract from a description of the plant appearing in the Nov. 1 to Dec. 27 issues of *Engineering*, London.

HAMS HALL generating station, some nine miles east of the center of Birmingham, England, has been designated by the Electricity Commissioner as a selected station and one of the key plants in the Central England electricity scheme, which provides for conversion of frequencies in the Birmingham area from 25 cycles to 50 cycles. Since the transmission network for the 50 cycle conversion has not yet been constructed, it was felt that the first section of this plant should be designed to generate at 25 cycles. Arrangements were made whereby the rotors of the generator may be replaced and their stators rewound with a minimum of trouble for generating at 50 cycles when the time comes to place the Central England electricity scheme in effect.

The first section of this plant contains two 30,000-kw. units, with an estimated ultimate capacity of 240,000-kw. Total cost of construction for the first section has amounted to £1,336,400 ($6,500,000).

The plant is located at the center of four large coal fields, from which fuel is received by rail. The 20-ton coal cars are shunted by a steam locomotive onto a gravity feed siding so that they run to the incoming side of one of two car tipplers. These tipplers are of the side-discharge type, and each can deal with ten 20-ton cars per hour. They are equipped with weighing machines, which are erected in the pit immediately below the table that carries the car. Two bucket conveyors elevate coal from the tippler hoppers, and discharge it onto two inclined belt conveyors that carry it to the level of the boiler house bunkers. These conveyors discharge the coal onto either of two shuttle-belt conveyors, which distribute to the boiler bunkers. One 400-ton bunker is provided for each boiler. They are of parabolic form, and arrangements have been made for mechanically agitating the coal in case it holds up in the bunker.

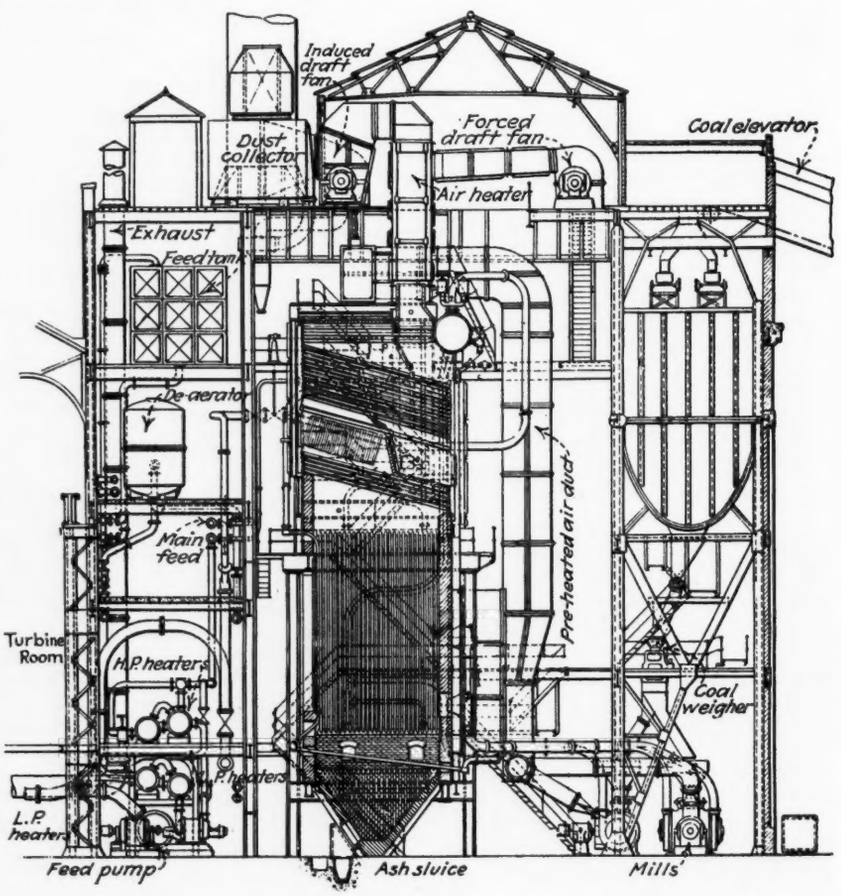
Rather elaborate arrangements have been made for storage and for retrieving coal from storage, the conveyor for this purpose being 525 ft. long. The coal-handling equipment, both to storage and to bunker, is designed for 100 tons per hour.

This is the first central station in England designed to use only pulverized fuel. Coal is delivered direct from the boiler bunkers to the pulverizers, five of which are provided for each of the five boilers. They are all of the atritor type, each capable of grinding four tons of coal per hour. One of the five mills associated with each boiler is driven by a 144-hp. direct-current motor, and the other four by 120-hp. alternating-current motors. Normally, one of the latter units will be spare, and variations in load will be secured by altering the speed of the direct-current-driven units.

Each mill supplies coal to one turbulent-type burner installed in the front wall of the furnace. Air for supporting combustion is heated to 350 deg. in 40,800-sq.ft. air preheaters and delivered by one 70,000-c.f.m. force-draft fan per boiler to adjustable vanes in the periphery of the burner. A portion of the preheated air is used in the mills to dry the coal.

The main steam-raising equipment consists of five boiler units, each having a normal evaporating capacity of 190,000 lb. per hour when fed with water at a temperature of 295 deg., and a maximum capacity of 228,000 lb. per hour under similar conditions. Steam is generated at a pressure of 375 lb. and superheated to a total temperature of 710 deg. The boiler tubes are 4 in. in external diameter and expose a surface of 20,000 sq.ft. to the gases.

The combustion chamber is completely water-cooled on three sides by fin tubes, which are expanded into headers and form part of the boiler circulatory system. A water screen made up of 4-in. tubes and having a heating surface of 360 sq.ft. protects the floor of the furnace. The furnace has a volume of 14,000 cu.ft. The front wall of the boiler is composed of high-grade refractory brick and building tiles, and, with the ash hopper, comprises the only refractory material exposed to furnace heat. Two induced-draft fans per boiler draw the flue gas through air preheaters and deliver it through dust



Section through boiler room of Hams Hall generating station

collectors to 8-ft. 6-in.-diameter stacks, of which there are five, one serving each boiler. The induced-draft fans have a capacity of 117,000 cu.ft. of air per minute, and are driven by 132-hp. 440-volt, three-phase motors.

Ashes are removed by an hydraulic sluicing system and delivered to a 35-ft. 6-in.-square sump. Three 6-in. vertical-spindle type pumps are installed for delivering water for this purpose, each pump being capable of handling the ashes discharged from three boilers.

Water required for boiler-feed purposes is obtained from the Birmingham Water Department and is treated in a softening plant having a capacity of 12,000 gal. an hour. This plant consists of a lime-soda softener to reduce hardness, a sand filter plant to remove suspended matter, and base exchange units to eliminate residual hardness. The water is delivered to a 5,850,000-gal. reinforced concrete reservoir.

The two 30,000-kw. units now installed are of the single-casing type and operate at a speed of 1,500 r.p.m. Each also drives a 400-kw. auxiliary generator, and an exciter mounted on an extension of the shaft. Steam is first expanded in a velocity stage, with two rows of blades, after which it passes through 30 rows of blading. The blading in the high-pressure portion is of nickel steel as far as the ninth stage, but beyond there stainless steel is used for the moving, and rustless iron for stationary low-pressure blading.

Three-Point Extraction From Main Unit

The units are designed for extracting steam at three points for feed-water heating. Provisions have been made to take care of condensate formed in the last stages of the turbine. The water formed is ejected past the shrouding on both inlet and outlet sides of the moving blades. Ejection is assisted by the fact that the channels are shaped so that the water is prevented from running back into the blading.

The generators are provided with air coolers capable of reducing the temperature of 75,000 cu.ft. of air per minute from 130 to 85 deg. The coolers have been provided with leakage-detecting devices, and with dampers that automatically open the circuit to atmosphere in case generator temperature rises above a predetermined value.

In addition to the main generator, the station includes two 1,875-kw. house sets that generate direct current at 460 volts. Turbines used on these sets have nine impulse stages, and operate at 3,000 r.p.m. Auxiliary power can also be obtained from two 500-kw. motor-generator sets.

Main units exhaust to two double-pass condensers each having 45,000 sq.ft. of cooling surface. Cooling water in the form of sewage effluent is supplied to each condenser by two 21-in. vertical pumps, each capable of delivering 15,170 gal. of water per minute. These units are driven by 400-hp., 440-volt, direct-current motors. To insure continuity of service, one of the pump motors is connected to the auxiliary generators, and the other to the house-service bus line.

Cooling Towers Largest in England

Sewage effluent is cooled in two reinforced concrete cooling towers, which are circular in plan and hyperbolic in elevation. They are the largest that have been constructed in England and are designed for maximum hourly circulation of 5,000,000 gal. The hyperbolic elevation facilitated construction, since it was possible to erect the structure as a shell without introducing beams or stiffening of any kind, in spite of the fact that the height of the towers above the pond level is 210 ft. and their maximum diameter is 168 ft.

Condensate is removed from the condenser by two double-impeller vertical-spindle pumps of 625-gal. capacity through a drain-mixing box into which the condensate from various heaters is discharged. The pumps discharge through the steam jet air pump coolers, drain coolers and low-pressure heaters, where the condensate is heated to 208 deg. by steam extracted from the main turbine at a pressure of 15.6 lb. absolute.

From there the water may flow either to a feed-water storage tank or a deærator heater from which it is delivered to the boiler-feed-pump suction.

Three feed pumps are provided, two electrically driven and one steam operated. They have a maximum output of 50,000 gal. per hour and deliver water against a pressure of 480 lb. Excess-pressure regulators are installed at the discharge of the pumps.

The feed pumps deliver the water to intermediate- and high-pressure heaters and thence through a Venturi meter to duplicate feed mains, from where the water is fed to the boilers through feed-water regulators. Both the high- and intermediate-pressure heaters for each unit consist of two heaters in series, with a total surface of 2,570 sq.ft. They are designed to maintain a final temperature of 311 deg. under maximum rating conditions.

Off-Peak Power Used to Heat Water for Processes

AT THE plant of the Northern Chromium Co., Ltd., Newcastle-on-Tyne, England, water is heated electrically and stored during the off-peak period at night. The method was described in *Engineering*, London, Jan. 17. The water is used for heating the electrolyte in chromium electroplating tanks. The storage tank has a capacity of 5,650 gal., and the water is heated by four banks of immersed heaters. Each bank requires 30 kw., or a total of 120 kw. for the four.

Energy for heating is taken from the local power company's lines and is obtained at a special low rate. Power is switched on at 7.30 p.m. by a time switch and is disconnected by a thermostat when the water reaches a temperature of 212 deg. F. Heating the electrolyte is done by circulating the water from the storage tank through coils in the electroplating tanks. The hot water is circulated by a small pump. At the end of the day the temperature of the water has dropped to about 140 deg. F.

Compared with steam heating, the system has the advantage of eliminating the use of traps. Since the peak demand for heat is at the beginning of the day, if the heating were done by steam the boilers would have to be brought to steaming condition before starting the processes. During the time of heating the tanks to working temperature the demand for steam is at a maximum and for the rest of the day the steam requirements are small. This condition is not conducive to efficient operation of the boilers. Labor cost has been materially reduced, as the hot-water storage system is entirely automatic.

Canadian Paper Mills Study Byproduct Power

SOME interesting observations on the use of steam power in Canadian pulp and paper plants were given in a report by the committee on byproduct electric power generation at the recent annual meeting of the Canadian Pulp and Paper Association.

"Within the last few years," reads the report, "improved economy of steam generation and utilization have advanced to the stage where consideration must be given at least to that portion of steam power potentially available as a byproduct of the mill demands for process steam. It is appreciated that the economic objectives will vary with different mills, depending on mill location and local conditions. The general factors entering into the economic analysis, are, however, essentially comparable—namely, determination of the relative cost of generated byproduct electric power compared with purchased electric power. This subject can be considered under two headings:

"1. Specific data of byproduct power possibilities to be realized by both increase of operating steam pressure and the expansion to such lower pressures as may be potentially available through improvement of process.

"2. Data concerning the turbine manufacturers' developments in this field and their present position relative to tailoring designs to best suit particular operating conditions.

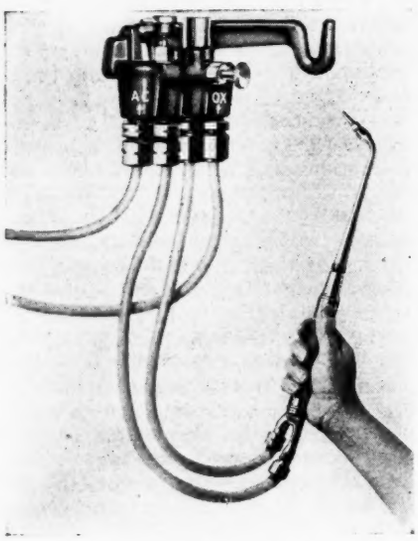
"Turbine manufacturers, being asked to co-operate in obtaining the above data, in general recognized the problems of the paper manufacturer and gave evidence on their part of the development of many turbines of special type available to the industry. Industry probably does not require the development of commercial turbine types other than those already in use, but great responsibility lies with the paper manufacturers to be able to properly state their requirements and to know when such requirements are adequately met and fulfilled."

What's New in Plant Equipment

HOW THE MANUFACTURER CONTRIBUTES TO THE JOB OF GENERATING, TRANSMITTING AND APPLYING THE POWER SERVICES

Automatic Shut-Off for Welding Gases

A SHUT-OFF for welding gases, known as the Rego "Economizer," has been developed by the Bastian-Blessing Company, 240 East Ontario St., Chicago, Ill. With this shut-off no gas is burned while the operator is setting up the work, and none is wasted while he is readjusting the flame. A neutral flame is obtained as soon as the welding torch is lifted from the torch arm. Both shut-off valves in the unit are of the diaphragm type. A simple

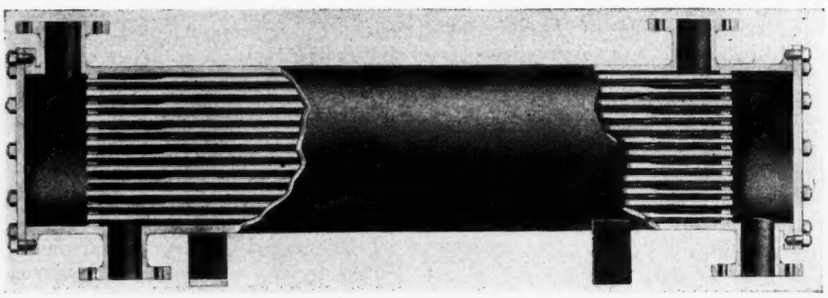


Hanging torch on arm closes off both valves

wall bracket may be supplied for holding the economizer and the various tips.

Heat Exchanger With Closely Spaced Swaged Tubes and No Baffles

ELIMINATION of baffles and a material increase in the amount of surface in a given size of shell, are distinctive features of the new heat exchanger designated Equaflow brought out by the Griscom-Russell Company, 285 Madison Ave., New York City. These improvements have been made possible by the use of tubes which are swaged down at one or both ends to permit closer spacing of the tubes in the shell and at the same time retain sufficient strength in the tube sheet.



Cut-away view of "Equaflow" heat exchanger

This close spacing of the tubes in the shell has the additional effect of making the area of flow through the shell or across the tubes equal to the area of flow through the tubes, which heretofore has been obtained in most cases only by the use of baffles.

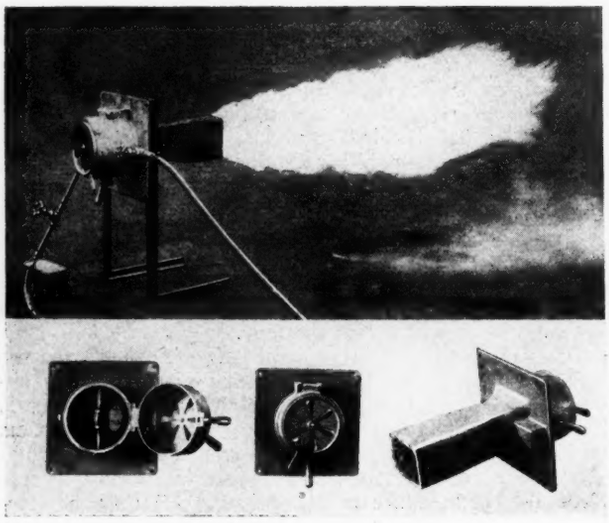
The exchanger is available in four styles or types giving various arrangements, such as with or without floating heads, tubes swaged at one or both ends, tubes of steel or Admiralty metal and tube sheets of steel or naval bronze; and in three pressures, 75, 150 and 250 pounds.

Igniter for Pulverized Coal Fires

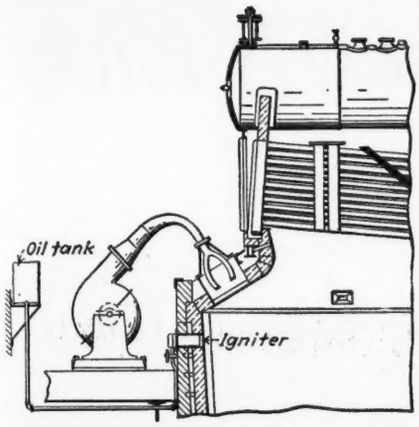
TO PROVIDE a means of furnishing safe, certain and smooth ignition to powdered coal fires and thus eliminate danger of blow back from slow or retarded ignition, the igniter shown in the accompanying illustration has been developed by Schuyler C. Page, 146 Devonshire Court, Rochester, N. Y. The views show the igniter in operation in the open, and a detail of the parts which is self-explanatory, also a section of a boiler setting with the igniter in position for lighting a furnace arranged for vertical flame firing. Ability to burn a wide variety of fuel, varying from gasoline to 19 Baumé crude, is an important feature of the igniter.

In addition to its primary use, that of furnishing ignition, it is particularly suitable for drying out brick settings and getting up steam before lighting powdered coal fires. Any desired flame may be obtained by regulating hand valves, and both steam and compressed air may be connected to the same atomizers.

Igniters of this type are being operated on gasoline, kerosene d[illegible]



View of igniter in operation and detail of parts



Cross-section of boiler setting showing igniter in position

tillate, transformer and switch oil, crankcase drawings from trucks, and waste oil from the power plant in general, and also on 19 Baumé crude heated 150 to 175 deg. F.

Phosphate in a New Form for Water Conditioning

ANNOUNCEMENT is made by Hall Laboratories, Inc., Pittsburgh, Pa., of a new chemical for boiler water conditioning known as Hagan phosphate. This new chemical, it is claimed, overcomes the inherent problems encountered in the use of tri-, di-, and monosodium phosphates for boiler water conditioning.

The chief difficulty in the use of phosphate in these forms was the fact that while it throws down calcium in the boiler in the form of sludge, thereby maintaining the boiler free from scale, it brings about the precipitation of calcium in the form of adherent scale in the pump, feed lines, valves, etc., leading to the boiler, if the phosphate is fed to the feed-water system.

The two methods of overcoming this, the addition to the phosphate of a tannic acid body such as cutch or quebracho and the use of individual chemical pumps to feed the phosphate directly to each boiler, presented operating difficulties and certain objections. Further complicating the question of treatment for the prevention of scale was the necessity of maintaining the recommended ratio of sodium sulphate to counteract alkalinity in the boiler water.

Among the claims made for the new chemical by the manufacturer are: It provides phosphate as a suitable negative radical required to maintain the equilibra necessary for scale prevention; enables the proper alkalinity to be given the feed water to protect feed lines, economizers, etc., from corrosion, and reacts in the boiler proper to reduce alkalinity as a protection from embrittlement and wet steam; it can be put into the feed-water system of the plant without precipitating calcium and plugging up feed lines, valves, etc. It is readily soluble in water and in its commercial form its analysis is definite and unvarying.

The new products will be distributed by the Hagan Corporation, Pittsburgh, Pa.

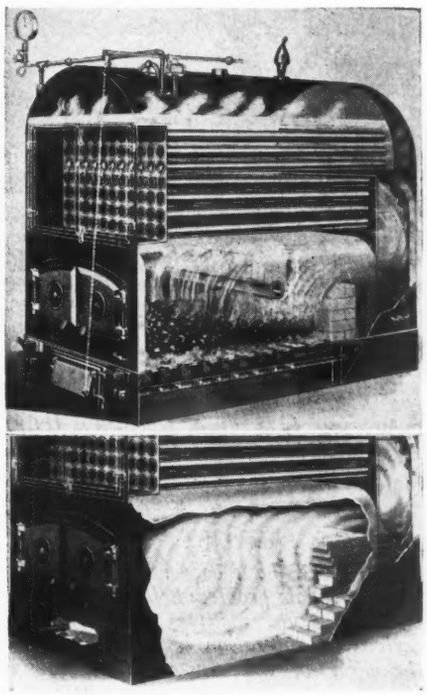
Steel Heating Boiler

A COMBINATION of old methods of proved merit and modern ideas of design are embodied in the construction of the new steel heating boiler brought out by the Erie City Iron Works, Erie, Pa. It can be fired with either soft or hard coal, oil or gas and can be used for either steam or hot-water heating.

In a coal-fired setting, a slotted refractory curtain wall supported on a water tube, and a refractory bridge wall are used, as shown in the upper view. This gives a long firebox and tends to insure combustion of the gases before they enter the return tubes.

The front and rear smoke boxes are built into the boiler. This construction, in addition to relieving the boiler of any overhanging parts, reduces air infiltration and aids in keeping down the boiler room temperature. Design of the firebox crown sheet is such as to avoid as far as possible any pocket for the collection of mud or sediment over the fire, and to be practically self-cleaning.

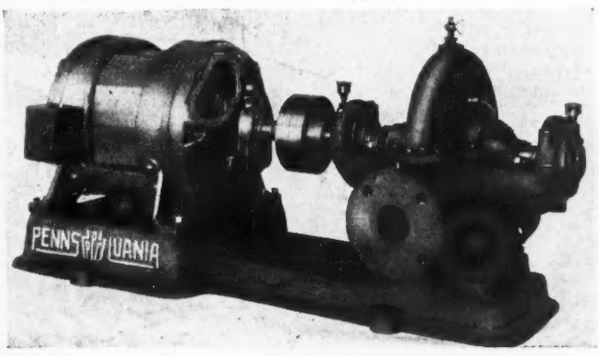
All boilers included in this line are built for a working pressure of 30 lb., and the sizes range from 259 sq.ft. of heating surface to 2,153 sq.ft., with corresponding capacity in square feet of radiation from 3,500 to 28,000, respectively.



Boiler arranged for firing with coal and oil

Single-Stage Double-Suction Centrifugal Pump

A LINE of single-stage centrifugal pumps in two classes BMD and BHD is announced by the Pennsylvania Pump & Compressor Company, Easton, Pa. A bronze impeller of the double-suction inclosed type is carried by a shaft of special alloy stainless steel running in deep-groove ball bearings inclosed in sealed housings. The pump casing is split horizontally, with the inlet and outlet connections as well as the bearing bracket cast intergral with the lower half. This casing also embodies a balancing port connecting the two suction chambers at the impeller inlet, thus preventing end thrust. Unusually deep stuffing boxes with brass water seals, solid bronze glands and bronze swing bolts are used, the water seals being connected to the discharge casing without valves. Both classes of pumps are made in a number of sizes and capacities.



Motor-driven single-stage unit

Events and Men in Power's Field

THE EDITORS WILL WELCOME THE CO-OPERATION OF READERS IN REPORTING INTERESTING HAPPENINGS, PERSONAL OR OTHERWISE

*Spot * News*

AN INTERNATIONAL *public utility holding and management company, patterned along the lines of Electric Bond & Share Corporation, has been organized recently under the laws of Canada by prominent American and European interests. With a reported capital of* $36,000,000, *the new European Electric Corporation, Ltd., will be interested directly or indirectly in public utility enterprises in France, Germany, Italy, Austria, Spain, Poland and Greece.*

* * *

HEARINGS *have been reopened on the Muscle Shoals problem before the House Committee on Military Affairs, and serious consideration is being given to the offer of the American Cyanamid Company to purchase and operate the plant. At the same time the Senate Lobby Committee is investigating the Muscle Shoals propaganda activities of the Tennessee River Improvement Association.*

* * *

AN ORDER *for the first hydrogen-cooled synchronous condenser to be used west of the Mississippi River has been placed by the Southern California Edison Company with the Westinghouse Electric & Manufacturing Company. Rated at* 15,000 *kva., the condenser will be placed in operation at the company's San Antonio substation.*

* * *

FINAL AGREEMENT *between the states on the division of water from the Boulder Dam project had not been reached up to the time of going to press. The Phoenix, Ariz., meeting adjourned early last week with Arizona's long standing contentions practically satisfied, but the Imperial Valley and Los Angeles interests are now contesting as to their shares of the main stream waters.*

* * *

CONSTRUCTION *of a power plant using the sun's rays has been started in Samarkand, Turkestan. It will have a capacity of 210 hp. and will be the first of its kind in the Soviet Union.*

Japanese Progress in Research Cited by Sperry at New York Reception

JAPAN is the best equipped for research of any nation in the world, Dr. Elmer A. Sperry, past president of the American Society of Mechanical Engineers, told members of the society and their friends at an informal reception held in the Engineering Societies Building, New York City, on the evening of Feb. 10. The reception was given to Dr. Sperry in honor of his return from Tokio as chairman of the American Committee of the World Engineering Congress, which was held in that city last October.

Outlining in an informal manner his impressions of Japanese progress and the World Engineering Congress, Dr. Sperry said that amazing things had happened in that country since his visit seven years ago. He went there last October expecting to find the curve of Japanese progress drooping slightly, or at best flattening out, but instead he found it was rising at the same rate as on his previous visit. During those seven years, he said, 300 research laboratories had been built and equipped, among which was a laboratory devoted to aviation that covered an area of eight acres.

"Nothing like it exists in any other country," he declared, "and no other nation is so well fitted for research. The temperament and interest in detail of Japanese scientists and engineers makes them admirably adapted to research work. Where we in this country follow an investigation to a certain point and stop, they push through to the end. They have no tradition to hold them back; no one admits a problem is impossible of solution until it has been proved so beyond a shadow of doubt.

"Likewise, in other fields their enterprise and industry is apparent. They are doing things there now that we are looking forward to accomplishing in ten or fifteen years. Their industrial works are enormous both in the amount of money invested and engineering skill used in creating them. They improve on everything they adopt. Obsolete equipment is not tolerated; the latest machinery is installed as soon as it has been perfected."

Turning to the World Engineering Congress, Dr. Sperry lauded the Japanese on the efficient way they handled the entire affair. Abstracts of 800 papers, of which 435 were prepared by Japanese engineers, were presented according to schedule without a hitch. At times sixteen sessions were run simultaneously without the slightest confusion, and the utmost courtesy pervaded the entire proceeding. Dr. Sperry was particularly impressed with the large and alert student body present at every session he attended. He said he had never witnessed a group of young men

who were so eager to learn and who followed the complex engineering discourses with so much intelligent appreciation.

Entertainment of the delegates to the congress surpassed anything he had ever encountered, said Dr. Sperry. The utmost consideration and hospitality prevailed at all of the 91 social events.

In closing, he emphasized the growing importance of the engineer's position in world affairs. "He is taking the place of the politician, and even the statesman, as an ambassador of good-will among civilized nations of the world," said Dr. Sperry, "and his prestige will increase more and more as he continues to devote himself to the service of humanity."

Previous to the reception, Dr. Sperry was entertained at a dinner given to him by members of the A.S.M.E. council and officers of the Metropolitan Section. There he related his more personal experiences and described the ceremony at which he was decorated with the Order of the Sacred Treasure of Japan.

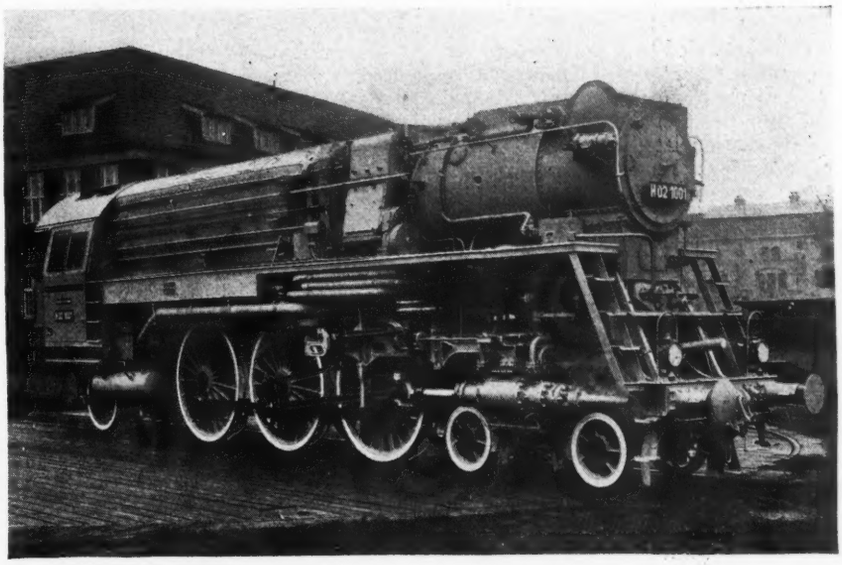
James Watt Named Greatest Engineer of All Times

The greatest engineer of all time is James Watt, improver of the steam engine, the deans of American engineering schools have decided. A list of the greatest engineers, both of all time and of the last 25 years, was made public today for the first time when the students in the School of Technology, Villanova College, met to make plans for the celebration of the 25th anniversary of the engineering department. The celebration will be held in June.

Dean Carl T. Humphrey of the Villanova School of Technology invited every dean of engineering in America to name the greatest engineers. Their selections appear in two groups; the five outstanding engineers of all time being: James Watt; Leonardo da Vinci, who planned and constructed the Martesana Canal; Thomas A. Edison; James B. Eads, boat and bridge engineer; Ferdinand de Lesseps, French engineer who built the Suez Canal and projected the Panama Canal.

The Villanova survey shows that the ten greatest engineers of the last 25 years are: Herbert Hoover, for his work in mining and administration; Charles P. Steinmetz, electrical genius; Thomas A. Edison; John F. Stevens, for his work on the Panama Canal and as head of the American Railway Mission to Russia, 1917-18; John Hays Hammond, mining; George W. Goethals, engineer-in-chief of the Panama Canal; George W. Westinghouse, airbrake inventor and pioneer in introducing alternating-current machinery; Guglielmo Marconi, inventor of wireless telegraphy and responsible for first broadcasting in England; Henry Ford; Ralph Modjeski, engineer of the Delaware River Bridge at Philadelphia and Ambassador Bridge, which connects Michigan and Ontario, Canada.

A 1,700-lb. Steam Plant on Wheels



THIS new Loeffler high-pressure locomotive of the German Railway Company uses steam at 1,700 lb. pressure and 900 deg. F. It operates on the "steam-pumping" principle used in stationary Loeffler plants. It is said that preliminary tests and calculations promise a fuel saving of about 45 per cent compared with the latest standard models of the German Railway Company. This locomotive was built at the Maschinenbau-A.G., vorm. L. Schwartzkopff, and is the outgrowth of experimental work at the Vienna locomotive factory where the first stationary boilers of this type were installed. The locomotive will be exhibited at the World Power Conference next June.

Meetings on Management and Materials Handling

From March 3 to 5, inclusive, the National Management Congress, sponsored by five national societies, will convene at the Stevens Hotel, in Chicago, Ill. During the latter part of the week, March 5 to 7, the Materials-Handling Division of the American Society of Mechanical Engineers will hold its third national meeting at the same hotel. This group will participate with the management congress in the Wednesday afternoon inspection trips and the banquet on Wednesday evening. During the management congress the A.S.M.E. committee on the elimination of waste will hold its first meeting of the 1930 campaign under the general title of "Progress in Waste Elimination." On March 5 and 6 the First Industrial Marketing Conference will be held at the Blackstone Hotel by the Industrial Marketing Division of the American Management Association.

Apart from these technical gatherings, but of common interest to all, there will be a national industrial equipment exposition that will display equipment, supplies and services to be found in the management and industrial fields. The exposition also will be held at the Stevens Hotel and will continue throughout the week.

Nine sessions have been arranged for the National Management Congress opening with addresses on economic aspects of management in the future, the development of organized management, and science and philosophy since Taylor. "Organizing for permanent prosperity" expresses the keynote of the meeting. For the materials-handling meeting six sessions have been arranged and a group of inspection trips to nearby plants. The program will cover widely diversified materials-handling systems, recent developments, standardization and other phases.

Colorado Association Fights Engineers' Union

The Colorado Association of Engineers is embattled against attempts of the Denver Trades and Labor Assembly to form a union of "technical" men, intended as an affiliation of American Federation of Labor. The association maintains this move to be "a direct challenge to its ability to serve the profession adequately in the matter of engineering employment," and lists the following as reasons for opposing a union of engineers:

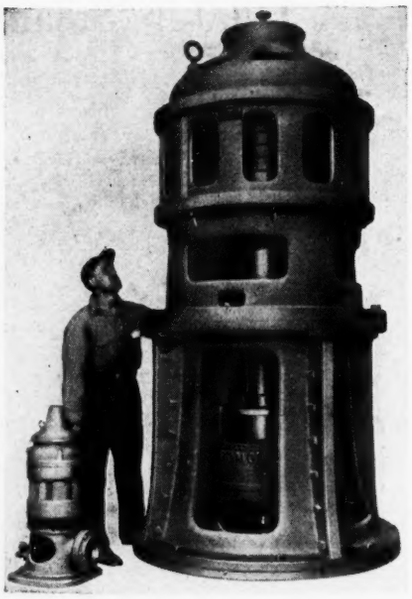
"Collective bargaining, the weapon of organized labor, would fail utterly in conditions under which engineers and technical assistants of the West usually are employed, *i.e.* a wide diversity in kind and location of employment;" and, "every engineer, if he is worth his salt, likes to consider his calling a profession rather than a trade, and the learned professions place their services on a plane quite different from the tradesman or laborer."

Giant Deep-Well Pump Lifts Water 850 Ft.

What is termed "a giant" among turbine pumps recently was constructed by the Pomona Pump Company, Pomona, Calif., for the Cia Industrial El Potosi for installation at Zacatecas, Mexico. The shipment required two railway freight cars and weighted 48,000 lb. without the electric motor.

The following description has been furnished by the manufacturer: The distance from the top of the motor to the lowest portion of the pump bowls measures 864 ft. The problem of proper lubrication and prevention of whipping in a drive shaft of such great length was successfully solved by using a water-lubricated resilient type bearing. The shaft floats within a film of water and all vibrations are completely cushioned. The braking effect of an oil-filled tube, due to the viscosity of the oil, would have meant a great loss of power, according to the designers.

Twenty-five individual pump stages on bowls were used. Twelve of these were installed about 400 ft. underground and the remainder were at the 833-ft. level. Only one shaft is used, as the separate sets of stages drive from the same motor mounted at the surface. The capacity of each set is synchronized. An ingenious regulating device immediately below the top group compensates for increase in shaft length as the hydraulic load increases. Impellers have no lower shroud and are adjustable from the surface to compensate for eventual wear. The total weight of all moving parts is transmitted to an immense roller bearing in the pump head. This bearing runs in oil, the temperature of which is controlled by water-cooling coils.



Driving head of 864-ft. pump compared with ordinary size

C.E.S. to Celebrate 50th Anniversary

The Cleveland Engineering Society is to celebrate on March 14 and 15 the 50th anniversary of its founding. The Hotel Hollenden has been chosen as headquarters for the two-day gathering, to which the Society has issued a most cordial invitation to all engineers but particularly those of Ohio and neighboring states.

Trips will be featured to ten plants and engineering projects in the Cleveland district, each point visited being an outstanding representative of a different type of interest. Included are the Baldwin filtration plant and pumping station, Industrial Rayon Corporation, Warner & Swasey Company, Glidden Company, Hupp Motor Company, National Lamp Works, American Steel & Wire Company, Southerly Sewage Works, and the Cleveland Union Terminals.

Each trip will start with a brief talk at the plant visited on engineering development in the industry represented by that plant.

An informal dance will be held at the Hotel Hollenden on Friday evening, and a banquet on Saturday evening will close the celebration. On the banquet program will be addresses by well-known speakers on contributions of engineering to civic, social and industrial progress, some brief ceremonies suitable to the occasion, and entertainment features.

Experts Submit Report on Seattle Plant

Among the recommendations in the report recently submitted to the City Council by Lybrand, Ross Brothers & Montgomery, the City of Seattle's efficiency experts on the municipal light department, is the complete reorganization of the city light department under either a superintendent or a non-salaried utility commission. Division of departmental administration is proposed along three lines, with an executive superintendent at the head, as follows: (1) commercial and financial; (2) operating, (3) engineering.

One of the three division heads is suggested to be an official authorized to act for the superintendent in his absence. Control over light department engineering is given by the charter to the city engineer, and this arrangement should be changed, the experts recommend. If it is not, they propose that the department engineer take over responsibility for planning and supervision over technical features of ordinary maintenance and service extension and such experimental work as may be recommended.

The report was read before the council as a whole, with newspaper representatives present, and J. D. Ross superintendent of the department, presented a report at the same time, in which he charged that interference from the City Council and the city engineering department had been responsible for many costly mistakes and delays connected with city light affairs for which he, personally, had been blamed.

The city light department's earnings for 1929 were approximately $5,300,000, or almost $80,000 higher than the estimate made at the beginning of the year, and 9 per cent higher than for 1928. Total current generated in 1929 was 264,959,930 kw.-hr., an increase of 18.5 per cent over that of 1928. The maximum demand for this winter up to date was 117,867 hp., an increase of 15.1 per cent over that of 1928.

Plan Sauk River Plant

Plans for a $6,000,000 hydro-electric power development have been revealed by an application filed recently with the Washington state hydraulics office in Olympia for appropriation of 3,500 sec. ft. of water from the Sauk River, Skagit County, and for use of Sauk Lake as a reservoir, by the Pacific Development Company, of Olympia. Lars Langloe. Olympia hydraulics engineer, is president of the company, and R. K. Tiffany, former state hydraulics supervisor, is consulting engineer. A concrete dam 220 ft. high and 1,200 ft. long on top is to impound 380,000 acre-ft. of water in Sauk Lake reservoir, while a fall of 185 ft. is to be used in developing 73,580 theoretical horsepower of electric energy.

Removal of Coal Tariff Draws Sharp Protest

Elimination by the Senate of the countervailing duty of 50c. per ton on bituminous coal imported from Canada brought such a vigorous protest from the domestic industry that it is confidently expected the Senate will reconsider its action. Repeal of the duty was voted on a motion by Senator Smoot, tariff leader in the upper house, who explained that in response to a suggestion from the State Department it was his intention to move for striking out all countervailing duties now carried by the tariff bill. In presenting the motion with respect to coal, Senator Smoot neglected to mention the commodity involved and so far as the National Coal Association is aware, no one in the industry was notified of the proposal.

Although imports of bituminous coal from Canada, now are very small, amounting to only one-tenth of 1 per cent of domestic production, it is feared that removal of the duty would result in deep inroads into the New England market by Nova Scotia mines, at the expense of the Pennsylvania and southern West Virginia fields, and enable British Columbia mines to capture the entire Pacific Coast market from mines in Washington and the Rocky Mountain states. With free access into the United States, coal from Alberta also

would find a ready market in the border states from Minnesota westward.

The United States supplies practically all of Ontario's coal requirements and perhaps a third of Quebec's. With removal of the countervailing duty there would be nothing to prevent Canada from raising its duty to a higher figure except such resistance as the proposal might be expected to meet from the large industrial consumers in Ontario. The Dominion government is now trying to promote the use of coal from Alberta and Nova Scotia in the industrial provinces by providing for test movements at low rail rates. Neither this policy nor the preference of 15 cents a ton given to coal imported from the United Kingdom has appreciably affected Ontario imports from the United States, but the consumption of Nova Scotia coal in Quebec has increased greatly. An increase in the Canadian duty would raise the percentage of Canadian coal consumed in the Dominion and reduce the demand for American coal in the same amount. Curtailment of the Canadian market, however, is of small consequence compared to the great potential losses in domestic markets if Canadian coal were admitted free.

Tacoma Buys Steam Unit

The General Electric Company submitted low bid of $366,000 for furnishing a 27,777-kva. steam turbine-generator set and accessories to be used in the proposed municipal steam-generating plant to be constructed on the tide-flats in Tacoma, Wash. The city engineer's estimate was $375,000. Accessories include generator air-cooler, motor-generator exciter set, voltage regulators, etc. Plans for the generator plant proper are now being prepared. It is estimated that the entire project will cost approximately $2,000,000.

Maine Hydro System Uses No Steam Plants

Experimental use of high and low water conditions on rivers in Maine at different times of the year for the interchange of power have proven so successful in obviating the necessity of using steam plants that a permanent transmission system is being constructed, according to an announcement of the public utilities commission. The announcement says, in part:

"It was found by observation and after a careful study of the run off of the Saco River, upon which is located the hydro-electric plants of Cumberland County Power & Light Company, and of the Androscoggin and Kennebec Rivers, upon which are located hydro-electric plants of Androscoggin Electric Company and Central Maine Power Company, respectively, that the high and low water conditions occurred at different seasons of the year.

"In order to take advantage of those conditions, the Cumberland and Androscoggin companies in 1924 built an experimental interchange high tension line of 6,000 kw. capacity, extending from Lewiston to Portland and connecting the systems of the two companies. It was found by experiment that the Cumberland company at certain seasons of the year could obtain from Central Maine Power Company enough electrical energy to supply its customers, thereby obviating the necessity of starting its steam generating plant, and that the Central Maine company could procure electrical energy from the Cumberland company, obviating the necessity of generating electricity through its steam plant at Farmingdale.

"The interchange of power over this experimental line has been found to be so advantageous to the companies involved that it was decided by the Cumberland and Central Maine companies to build a new interchange high tension line with a capacity of 15,000 kilowatts."

Business Forecast

AS FEBRUARY progresses it becomes fairly apparent that a definite uptrend of business is under way. Basic industrial activity continues to increase steadily, and general trade appears to be lagging less behind industry. Though building activity at present is somewhat curtailed pending spring, announcements of plans for new construction are rapidly increasing. Statistics regarding unemployment, however, are somewhat at variance with each other.

Harmony Prevails at Hearing on St. Lawrence Bill

Perfect harmony of all interests concerned marked the hearing held in the New York State Senate Chamber, Feb. 11, on the Thayer-Cornaire bill to provide a commission to study the subject of development of St. Lawrence River water power.

Merwin K. Hart of Utica, chairman of the Committee of Twenty-Five, appeared before the committee and requested that the bill be so amended as to provide that the commission should consider and report upon all possible plans of development, and that it should not limit itself to a development by a state agency, even though development in such a manner seems to it entirely feasible and practicable. He said that declining industry up-state and an accompanying movement of factories to other states created an urgent need for a scale of lowest possible rates on water power.

Floyd L. Carlisle, chairman of the board of directors of the Niagara-Hudson Power Corporation, declared that his company felt it owed a duty to the people of the state of New York to aid in every way the development of the St. Lawrence River power and the incidental industrial development.

News of Canada

Power Exports and Output Reviewed —Moose Jaw Sells Municipal Plant—Alberta Launches Power Development Program

Exports of power from Canada to the United States occupied the attention of the Quebec Legislature for a time on Feb. 5. Camillien Houde, leader of the Opposition, declared that neither Ontario nor the Canadian Government would be able to cut off power being exported to the United States from Ontario. He took exception to a statement in a Toronto newspaper which held that the exports could be cut off. "That is not right," said Mr. Houde, "a people of 120 millions will not endure it. They will not permit their industries to be deprived of power." Hon. L. A. Taschereau, Premier of the province, reminded Mr. Houde that contracts with the Ontario Government stipulated that any Quebec power sold to Ontario must not be exported to the United States. So far as he was aware, this stipulation was being complied with by Ontario.

Total output of central stations in Canada in 1929 was 17,629,306,000 kw.-hr., including current generated from both water power and fuel. This compares with 15,931,447,000 kw.-hr. in 1928 and 14,231,196,000 kw.-hr. in 1927. Over 98 per cent of the central station output were generated by water power, though there was a considerable increase in the amount generated by fuel. The latter increased from 226,076,000 kw.-hr. in 1928, to 331,459,000 kw.-hr. in 1929.

Moose Jaw Sells Plant

After a quarter of a century of municipal ownership, the city of Moose Jaw, Saskatchewan, consented recently to the sale of its electric light and power plant to the Iowa Southern Utilities. The move carried by a sweeping vote of over 3 to 1, a two-thirds majority being required for the by-law to carry. By its passing, subject to ratification by the Saskatchewan Legislature, the largest power transaction in the history of the province will have been completed. Involved in the offer that has been accepted by the city is $3,500,000. This is the largest single sum of money to be offered for any public utility in the province. The voting brings to a close one of the bitterest battles in the Moose Jaw history, the power situation having been a bone of contention and discussion for over twelve months.

Alberta's Power Program

Indication that the province of Alberta is preparing to carry out an extensive program of hydro and steam development was contained in the speech from the throne at the opening of the provincial legislature on Jan. 30. The Lieutenant-Governor stated that the government had continued an investigation reported at the last session. Outstanding

technical advisers on both hydro and steam development were consulted during the past year, and a prominent firm of engineers has been retained to complete the survey and assemble all information with respect to the province's power resources and problems; in order that, with the greater jurisdiction that will result from the transfer to the province of its natural resources, the government may determine the most suitable polices to be carried out.

Green River Power Resources Analyzed in Report

Enormous quantities of potential power and numerous dam sites are discussed and analyzed in a report on "The Green River and Its Utilization" just completed by Ralf R. Woolley, federal hydraulic engineer in charge of the Salt Lake City, Utah, district. Besides the 730 miles of the river proper flowing in Wyoming, Colorado and Utah, the report includes a survey of nearly 50,000 square miles contained in the great basin drained by the river and its tributaries.

According to the report, the potential power of the basin totals 759,600 hp., while today there is less than 2,000 hp. developed. Thirty-one of the dam sites are in Utah and are capable of producing 547,000 hp., some 479,000 of which could be developed on the Green River itself. Nine sites in Wyoming, capable of developing 11,100 hp., and twelve in Colorado with a potential output of 201,000 hp., are emphasized in the report.

OBITUARY

CHARLES T. HUTCHINSON, president of the McGraw-Hill Company of California, died at Peralta Hospital, Oakland, Calif., Feb. 12. He was founder and editor of *Western Engineering*, and vice-president of the Dewey Publishing Company before joining McGraw-Hill in 1922. He served as president of the San Francisco Development League, chairman of the California Electrical Bureau and on the executive committee of the Pacific Coast Electrical Association.

FRED M. KIMBALL, advisory manager of the motor division of the industrial department of the General Electric Company, died Feb. 5, in Lynn, Mass. Mr. Kimball had seen many years of service with General Electric and was well known throughout the motor industry. He had been ill for some time. He was born in Barton, Vermont, July 7, 1861, and received his education in Massachusetts, including a course in electrical engineering at Massachusetts Institute of Technology. He was early associated with the Merchants Electric Light Company of Boston, the American Electric Illuminating Company and the Electrical Development & Manufacturing Company. In 1891 he entered the employ of the General Electric Company, New England district, and in 1898 was made manager of the small motor department at its formation. He was an associate member of the A.I.E.E., a member of the N.E.L.A., and Edison Pioneer and an honorary member of the Providence Engineering Society.

Coming Conventions

American Society of Mechanical Engineers. Fiftieth Anniversary Celebration at New York City, Hoboken, N. J., and Washington, D. C., April 5-9, 1930. Semi-Annual meeting at the Hotel Book-Cadillac, Detroit, Mich., June 9-12, 1930. Secretary, Calvin Rice, 33 West 39th St., New York City.

American Institute of Electrical Engineers. District meeting at Springfield, Mass., May 7-10. Annual summer convention at Toronto, Canada, June 23-27. Secretary, F. L. Hutchinson, 33 West 39th St., New York City.

American Society for Testing Materials. Annual meeting at Haddon Hall, Atlantic City, N. J., June 23-27. Secretary, C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

American Welding Society. Annual meeting at society headquarters in New York City, April 22-25. Secretary, M. M. Kelly, 33 West 39th St., New York City.

Association of Iron and Steel Electrical Engineers. Annual convention and iron and steel exposition at Broadway Auditorium, Buffalo, N. Y., June 16-20. Managing director, John F. Kelly, Empire Building, Pittsburgh, Pa.

Canadian Electrical Association. Annual Convention at the Manoir Richelieu via the S.S. "St. Lawrence," June 11-13, 1930. Secretary, H. M. Lyster, 405 Power Building, Montreal, Quebec.

Engineering Institute of Canada. Annual meeting at the Chateau Laurier, Ottawa, Ont., Feb. 12-14, 1930. Secretary, R. J. Durley, 2050 Mansfield St., Montreal, Que.

International Congress for General Mechanics at Liege, Belgium, Aug. 31 to Sept. 7, 1930. For information address Alb. Schlag, 4 Place Saint-Lambert, Liege, Belgium.

International Railway Fuel Association. Annual meeting at the Hotel Sherman, Chicago, Ill., May 6-9. Secretary, C. T. Winkless, Room 700, LaSalle St., Station, Chicago, Ill:

National Electric Light Association. Annual convention at Municipal Auditorium, San Francisco, Calif., June 16-20, 1930. Secretary, A. J. Marshall, 420 Lexington Ave., New York City.

National Marine Engineers' Beneficial Association. Annual convention at Hotel Barlum, Detroit, Mich., the week of Feb. 10, 1930. Secretary, A. L. Jones, 9th St. and Mount Vernon Place, N. W., Washington, D. C.

National Oil and Gas Power Meeting, under auspices of A.S.M.E. Oil and Gas Power Division and Pennsylvania State College, will be held at State College, Pa., June 12-14. Chairman, L. H. Morrison, c/o *Power*, 10th Ave. and 36th St., New York City.

New England States Association of the National Association of Power Engineers. Annual convention and exhibition of power machinery at the State Armory, Salem, Mass., June 19-20, 1930. Secretary, E. S. Daniels, 113½ Bridge St., Salem, Mass.

Second Plenary World Power Conference. Convenes at Berlin, German, June 16-25. Chairman of the American Committee, O. C. Merrill, Edmunds Building, Washington, D. C.

PERSONALS

COLLINS P. BLISS has been named dean of the New York University Engineering College to succeed Charles H. Snow, who is retiring in April. Mr. Bliss has served as associate dean since 1927 and has been associated with the college of engineering since 1896, when he was appointed an instructor in mechanical engineering.

E. D. JOHNSTON, who for the past 45 years has been connected with the P. H. & F. M. Roots Company, has resigned as its president and has retired from active business.

JAMES C. BARNABY, mechanical engineer in the New York office of the Worthington Pump & Machinery Corporation, has been made consulting engineer of the Buffalo works.

H. HOBART PORTER, chairman of the Engineering Foundation and president of the American Water Works & Electric Company, sailed recently on the steamship "Columbus" for a cruise around the world.

D. C. HORMELL, formerly assistant mechanical engineer on central station operation and design with W. S. Barstow & Company, in Reading, Pa., is now associated with the Byllesby Engineering & Management Corporation at Chicago.

GEORGE C. REINHARD, formerly chief chemist of Feedwaters, Inc., has recently joined the staff of the American Colloid Corporation.

R. F. SCHUCHARDT, chief electrical engineer of the Commonwealth Edison Company, has been appointed chairman of the subcommittee on electrical engineering of the National Research Council's science advisory committee of the World's Fair to be held at Chicago in 1933. H. W. FULLER, vice-president in charge of engineering and construction of the Byllesby Engineering & Management Corporation, is assisting Mr. Schuchardt by handling the committee work on generation of electricity.

H. W. SMALL, JR., formerly chief engineer of the Alcoa Power Company, at Arvida, Que., has accepted a position with the W. S. Lee Engineering Corporation and will be located at Charlotte, N. C.

M. V. SAUER, until recently with the Winnipeg Electric Company, of Manitoba, Canada, is now hydraulic engineer for the Beauharnois Construction Company, at Beauharnois, Que. B. K. BOULTON, formerly with the Duke-Price Power Company, at Arvida, Que., has taken a position as electrical engineer with the Beauharnois company.

Business Notes

Stone & Webster, Inc., on Feb. 12 announced plans for acquiring the $350,000,000 Engineers Public Service Corporation through an exchange of shares. The proposed acquisition provides for a stock exchange on the basis of six shares of the capital stock of Stone & Webster, Inc., for each ten shares of the Engineers Public Service Corporation's common stock. The plan has the approval of a substantial number of the stockholders of Engineers Public Service, according to a statement of Charles A. Stone, chairman of the board of Stone & Webster.

P. H. & F. M. Roots Company, Connersville, Ind., has merged with other interests and is now controlled by the Stacey Engineering Company of Columbus, Ohio. The new organization includes, besides the Roots company, the Connersville Blower Company, Wilbraham-Green Blower Company of Pottstown, Pa., and Stacey Brothers Gas Construction Company of Cincinnati, Ohio. Officers of the combine are: Carmi A. Thompson, president; Corwin Abbott, vice-president and general manager; Fletcher S. Heath, vice-president; Erle G. Meeks, secretary and treasurer.

Williams Gauge Company, Pittsburgh, Pa., has appointed the Factory Equipment Company, 309 Gratiot Ave., Detroit, Mich., to handle its products in the Detroit territory. C. L. Horn will represent the company in Tulsa, Okla., with offices at 314 Wright Building.

Austin Company, Cleveland, Ohio, has appointed Ralph Leavenworth assistant general sales manager. In connection with a general expansion program, the company announces the inauguration of electric welding of structural steel as a regular part of its construction service.

Tube-Turns, Inc., Louisville, Ky., is now represented in Washington and Oregon by the Asbestos Covering & Supply Company of Seattle, Tacoma and Portland.

United Engineers & Constructors, Inc., reports $81,600,000 of engineering and construction work completed during 1929, an increase of 19 per cent over 1928 operations. The value of contracts on the books as of Dec. 31, 1929, was $130,500,000, compared to $129,700,000 the year previous.

Morton-Clough Engineering Company, Canton, Mass., formed by a merger of the Morton Vacuum Breaker Company and the Clough Engineering Company, was incorporated for $100,000 instead of the figure given in this column last week.

With the Society Sections

A.S.M.E., Anthracite-Lehigh Valley Section. Meeting at the Necho-Allen Hotel, Pottsville, Pa., at 6 p.m., Feb. 28. Subjects: "The New Hellgate Plant at New York City," by J. B. Gaffney, Allentown, Pa., and "Electric Hoists for the Mining Industry," by A. J. Nicht, Milwaukee, Wis.

A.S.M.E., Louisville Section. Joint meeting with A.I.E.E. and Engineers & Architects Club at 403 Norton Bldg., on Feb. 18 at 8 p.m. Subject: "The Quest of the Unknown," by Prof. Harold B. Smith, president of the A.I.E.E.

A.S.M.E., Philadelphia Section. Meeting in the auditorium of the Engineers Club on Feb. 25 at 8 p.m. Subject: "The Relation of River and Harbor Problems to the Hydraulic Laboratory," by H. M. Eaton, Bureau of Standards.

A.I. & S.E.E., Philadelphia Section. Meeting at the Engineers Club on March 1. Subject: "Magnetic Clutches in Industry," by H. E. Hodgson, Cutler-Hammer Corporation.

A.S.S.T., Philadelphia Chapter. Meeting at the Engineers Club on Feb. 28. Subject: "Corrosion-Resistant Steels," by Henry A. De Fries, Ludlum Steel Company.

Cleveland Engineering Society. Fiftieth anniversary celebration meeting at the Hotel Hollenden, Cleveland, Ohio, on March 14-15.

Midwest Bituminous Coal Conference. Held under the direction of the Engineering Schools of Purdue University, Coal Trade Association of Indiana and Illinois Coal Bureau, at Lafayette, Ind., April 9-11. Chairman, W. A. Knapp, Purdue University, Lafayette, Ind.

Trade Catalogs

Stokers—Hand-fired stokers for bituminous and lignite fuels are described and illustrated in an attractive 8-page catalog recently issued by the McClave-Brooks Company, Scranton, Pa.

Pumps—Bulletins P1 and P2 of the American Manganese Steel Company, Chicago Heights, Ill., give operating data on recent installations of Amsco dredge pumps.

Meters—The use of graphic instruments to give a picture of the continuous operation of a plant as a whole is outlined in illustrated Bulletin 1229 published by the Esterline-Angus Company, Indianapolis, Ind.

Screens—Stephens-Adamson Manufacturing Company, Aurora, Ill., have recently issued an attractive 16-page catalog describing its new vibrating screen. Printed in color, the booklet contains construction details, dimensions, capacity data and installation photographs.

Preheaters—The subject of air preheating is well covered in a profusely illustrated 40-page booklet, No. 130, of the Air Preheater Corporation, Wellsville, N. Y. This bulletin contains several charts showing the savings obtained with air preheating, compares various types of equipment for this purpose, and discusses in detail the features of construction and operation of the Ljungstrom air preheater.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.30 @ $2.50
Kanawha	Columbus	1.40 @ 1.60
Smokeless	Cincinnati	2.00 @ 2.25
Smokeless	Chicago	2.00 @ 2.25
S. E. Kentucky	Chicago	1.40 @ 1.60
Steam	Pittsburgh	1.40 @ 1.65
Gas Slack	Pittsburgh	.90 @ 1.00
Big Seam	Birmingham	1.35 @ 1.50
Anthracite (Gross Tons)		
Buckwheat	New York	$2.70@$3.00
Barley	New York	1.40@ 1.50

FUEL OIL

New York—Feb. 13, f.o.b. Bayonne, N. J., 28@34 deg., Baumé, industrial use, tank-car lots, 4.75@5.5c. per gal.; f.o.b. Bayway, 36@40 deg., furnace, tank-car lots, 6c. per gal.

St. Louis—Feb. 6, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.695 per bbl., or 42 gal.; 26@28 deg., $1.745 per bbl.; 28@30 deg., $1.795 per bbl.; 30@32 deg., $1.845 per bbl.; 32@36 deg., gas oil, 4.401c. per gal.; 37@40 deg., distillate, 5.23c. per gal.

Pittsburgh—Feb. 3, f.o.b. local refinery, 30@34 deg., fuel oil, 4.5@4.75c. per gal.; 36@40 deg., 4.62½@4.75c.

Philadelphia—Feb. 4, 13@19 deg., $1.05@$1.10 per bbl. or 42 gal.; 22 deg. plus, $1.575@$1.625 per bbl.; 23@27 deg., $2.10@$2.15 per bbl.

Cincinnati—Feb. 4, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5.25c. per gal.; 26@30 deg., 5.5c. per gal.; 30@32 deg., 5.75c. per gal.

Chicago—Feb. 10, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl. or 42 gal.; 22@26 deg., 85@90c. per bbl.; 26@30 deg., $1.05@$1.10 per bbl.; 30@32 deg., $1.30@$1.35 per bbl.

Boston—Feb. 8, tank-car lots, f.o.b., 12@14 deg., Baumé, $1.05 per bbl.; 30@32 deg., 5c. per gal.

Dallas—Feb. 8, f.o.b. local refinery 26@30 deg., $1.35 per bbl. or 42 gallons.

New Plant Construction

COMPILED BY THE McGRAW-HILL BUSINESS NEWS DEPARTMENT, WHICH IS PREPARED TO FURNISH A MORE COMPLETE DAILY SERVICE TO THOSE WHO WISH IT

Ariz., Wittman—Arizona Water Conservation District of Wittman has filed application with Federal Power Commission for a preliminary permit to construct a power development, 10,000 hp. capacity in connection with irrigation project. Plans include four power houses, at Walnut Grove dam, Van Buren dam, Fools Canyon and Hassayampa River below Wickenburg.

Calif., Los Angeles—Los Angeles Gas & Electric Corp., 810 South Figueroa St., will build a 2 story, 50 x 100 ft. substation at 78th and Figueroa Sts. Estimated cost $200,000. Private plans. Work will be done by day labor.

Calif., Los Angeles—Sun Realty & Finance Corp., 1680 Vine St., is having plans prepared for the construction of a 12 story office building including steam heating system, three elevators, etc., at 629-33 South Hill St. Estimated cost $750,000. C. Beelman, 1019 Union Bank Bldg., is architect.

Calif., Pittsburg—Public Works Engineering Corp., 111 Sutter St., San Francisco, awarded contract for the construction of a pumping station here, to B. C. Gerwick, Inc., 112 Market St., San Francisco.

Calif., San Francisco—Great Western Power Co., 437 Sutter St., is having plans prepared for addition to substation on Bush St. Estimated cost $500,000. Weeks & Day, Financial Center Bldg., are architects and engineers.

D. C., Washington — U. S. Government, received lowest bid for removing turbo generators and installing Bleeder type in Capitol power plant from Washington Electric & Mfg. Co., Washington Bldg. $199,999.

Fla., Gainesville—State Bd. of Control, Hotel White House, will soon award contract for the construction of a unit to central heating plant at University of Florida.

Ill., Chicago—Commonwealth Edison Co., 72 West Adams St., awarded contract for three additions to electric substations at 115-19 North Dearborn St., 624-36 Kolmar Ave. and 3250-58 North Narragansett St. to Mid-Continent Co., 228 North La Salle St. Estimated total cost $520,000.

Ill., Chicago—Holabird & Root, 333 North Michigan Ave., Archts., will receive bids until Mar. 7, for the construction of a 21 story hotel including steam heating system, etc. on Madison St. for Morrison Hotel Co., Clark and Madison Sts. Estimated cost $3,500,000.

Ia., Dubuque — City is having preliminary plans prepared for the construction of a sanitary sewage system including three underground pumping stations, etc. W. Cullen, City Hall, is engineer.

Louisiana-Arkansas-Texas—Southwestern Gas & Electric Co., 122 East Broad St., Texarkana, Ark., will let contracts during 1930 for extensions and improvements to steam generating plants, additional sub-stations, erection of transmission and conversion equipment and new transmission lines, $2,850,000; office buildings, gas distribution lines, extensions, and improvements to street railways and ice plant improvements $500,000; miscellaneous and rural line extensions, etc., $650,000, in Shreveport, La., Texarkana, Marshall and Longview, Tex. and Fayetteville, Ark. Total estimated cost $4,000,000.

La., Mangham—Mangham Ice Co. Inc., P. Fudickar, Pres., will soon receive bids for the construction of an ice and cold storage plant. Estimated cost $40,000.

La., Lutcher—Louisiana Ice & Utilities Co., 402 Security Bldg., New Orleans, received lowest bid for the construction of a 70 x 90 ft. ice and power plant here from A. C. Stewart, Baton Rouge, $31,694. S. Stone, Jr. & Co., 1800 Masonic Temple Bldg., New Orleans, are engineers.

Mass., Bridgewater — Dept. of Correction, Boston, plans reconstruction and alterations to boiler house including two new boilers at State Farm, here. Estimated cost $40,000. Private plans.

Mass., Concord—Edison Electric Illuminating Co., Boylston St., Boston, plans the construction of a power sub-station, here. Estimated cost $50,000. Engineer not selected.

Mass., Saugus (br. of Lynn)—City is having preliminary plans prepared for the construction of a pumping station and equipment in connection with waterworks. Estimated cost $15,000. Fay Spofford & Thorndike, 44 School St., Boston, are engineers.

Mass., Waltham — Middlesex College of Medicine & Surgery, H. S. Card, Pres., 473 Beacon St., Boston, is having preliminary sketches made for the construction of a group of college buildings including power house on South St., here. Private plans.

Mass., Westboro — Dept. of Welfare, State House, Boston, plans the construction of a group of buildings including power house, etc. Estimated cost $400,000. Architect not selected.

Minn., St. Paul—Alverdes Restaurant, Inc., Anton Alverdes, 379 St. Peter St., plans the construction of a 12 story hotel including steam heating system, etc. Estimated cost $700,000. C. A. Hausler, 702 Minnesota Bldg., is architect.

Miss., Blue Mountain—City plans an election to vote $15,000 bonds for waterworks improvements including deep well, pumping station, pumping equipment, etc. J. B. McCrary Engineering Corp., 1408 Citizens & Southern Bank Bldg., Atlanta, Ga., is engineer.

Mo., Valley Park—St. Louis Carbonic Ice Co., 813 Hemstead St., St. Louis, is having preliminary plans prepared for the construction of a plant to produce vapor ice, a dry refrigerant and carbonic gas here. Estimated cost $300,000.

Neb., Lincoln—City is having preliminary plans prepared for developing a new water source on Platte River including pumping plant, mains, etc. Estimated cost $3,000,000. D. L. Erickson, City Hall, is engineer.

N. Y., Brooklyn—Giorgio Ice Co., Christopher and Newport Sts., plans the construction of an ice plant. Estimated cost $25,000. A. W. Barbour, Review Ave., Long Island City, is architect.

N. Y., Long Island City—New York & Queens Light & Power Co., Bridge Plaza, will award contract about Apr. 1, for the construction of a 9 story office building and service and storage building, at Roosevelt Ave. and Lawrence St. Estimated cost $1,075,000. T. R. Eilenberg, 42-22 Lawrence St., is architect.

O., Apple Creek — Dept. of Welfare, H. H. Griswald, Dir., Ninth and Oak Sts., Columbus, will soon receive new bids for the construction of two cottages and power house at Institution for Feeble Minded. Former contract declared invalid.

Okla., Hobart—Southwestern Light & Power Co., 517 Braniff Bldg., Oklahoma City, is having preliminary plans prepared for the construction of an electric switching station for power lines at Hobart. Estimated cost $25,000.

Tex., Goose Creek—City plans the installation of a municipal electric light and power plant. Estimated cost $50,000.

Tex., Refugio—City will receive bids until Feb. 24 for waterworks improvements including pumping unit, etc. Estimated cost $65,000. Hawley & Freese, Frost National Bank Bldg., San Antonio, are engineers.

Wash., Tacoma—City is having plans prepared for the construction of a steam generating plant on tideflats. Estimated total cost $2,000,000. J. C. Manley, is city engineer. General Electric Co., Witherspoon Bldg., Philadelphia, Pa., submitted lowest bid for a 27,777 kva. steam turbine generator set and accessories. $366,000.

Equipment Wanted

Boilers—Cleveland, O. — Bd. of Education, F. G. Hogen, Dir., will receive bids until Mar. 3 for steel boilers for Denison school.

Generator — Washington, D. C. — U. S. Engineer's Office, War Dept., will receive bids until Mar. 26, for a 1,000 kw. geared turbo-generator at Navy Yard, Portsmouth, N. H.

Pump—Meriden, Conn.—City, J. T. Toner, Supt. of Public Works, plans the installation of a pump at Kenmerealso. $4,000.

Pumping Unit, etc.—Refugio, Tex.—City will receive bids until Feb. 24, for a pumping unit, etc. in connection with waterworks improvements.

Pumps — Toronto, Ont. — City plans to purchase electrically driven centrifugal pumps for proposed extension to high level pumping station. Estimated cost $224,300.

Industrial Projects

Calif., Los Angeles—Mission Hosiery Mills, 3746 Moneta St., awarded contract for the construction of a 5 story, 63 x 94 ft. factory at 37th Pl. and Moneta St. to MacDonald & Driver, Bd. of Trade Bldg. Estimated cost $69,979.

Calif., Pomona—Courier Monoplane Co., 1255 West First St., Long Beach, plans the construction of a factory here. Estimated cost $50,000.

Calif., Richmond—Ford Motor Co., Dearborn, Mich., is having plans prepared for the construction of a 1 and 2 story automobile assembly plant, parts warehouse and dock for receiving parts and assembling and shipping automobiles here. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., is architect. Cranes and conveyors for dock equipment, conveyor system for assembly plant will be required.

Calif., San Francisco—R. N. Nason & Co., 151 Potrero Ave., awarded contract for the construction of a 6 story, 100 x 100 ft. plant factory on Utah St. to G. Wagner, 181 South Park St. Estimated cost $175,000.

Conn., Shelton—O. K. Tool Co., Hull Ave., awarded contract for 1 and 3 story, 80 x 180 and 25 x 40 ft. factory to The Austin Co., 11165 Euclid Ave., Cleveland, O. Estimated cost $75,000.

Ind., Indianapolis — American Tile Co., awarded contract for the construction of a 60 x 144 ft. factory at 1042 East Washington St. to A. Bertels, 1521 North LaSalle St. Estimated cost $44,000.

Mass., Boston—Batchelder & Snyder Co., 55 Blackstone St., awarded contract for the construction of a 4 story, 40 x 75 ft. addition to poultry dressing plant including electric refrigeration system on Blackstone St. to E. J. Farrell Co., 473 Tremont St. Estimated cost $50,000.

Mass., Malden (Boston P. O.)—E. J. Lamothe Co., 25 Chestnut St., Somerville, is receiving bids for a 1 story, 97 x 137 ft. factory at Willis Ave. and Green St. Estimated cost $50,000. Miller & Levi, 46 Cornhill, Boston, are architects.

Mich., Dearborn—Bopp Steel Corp., 4-237 General Motors Bldg., Detroit, awarded contract for a 1 story, 52 x 288 ft. steel factory on Maple Ave. here. Estimated cost $50,000. Work will be done by owners' forces. Electric motors and equipment for the manufacture of cold rolled steel for automobiles will be installed.

N. J., Camden—S. M. Langston Co., 6th and Jefferson Sts., awarded contract for the construction of a 2 story, 45 by 100 ft. factory for the manufacture of paper box machinery to Fearn & Vogtlin, 222 North 41st St. Estimated cost $45,000.

O., Youngstown—Youngstown Sheet & Tube Co., Stambough Bldg., plans the construction of a continuous sheet mill at Brier Hill works. Estimated cost $10,000,000. Private plans.

Pa., Philadelphia—Jacquard Knitting Machine Co., 924 Hunting Park Ave., will soon award contract for a 1 story, 75 x 216 ft. factory and 30 x 60 ft. garage at Ridge and Hunting Park Ave. Estimated cost $80,000. C. F. Scheaf, 11 South 16th St., is architect.

Tex., Sweetwater — Magnolia Petroleum Co., Magnolia Bldg., Dallas, plans the construction of a refinery plant, here. Estimated cost $4,000,000. Private plans. Work will be done by owners forces. Some equipment will be required.

B. C., Vancouver — Pacific Mills Ltd., 510 Hastings St. W., is having plans prepared for the construction of a 2 story, 120 x 260 ft. factory for the manufacture of waxed coverings, wrappers, fruit papers, towels, and other specialties at ft. of Campbell Ave. and Burwood Inlet. Estimated cost $150,000. Private plans.

Ont., Hamilton—B. Greening Wire Co. Ltd. Queen St. N., awarded contract for addition to plant for the manufacture of fencing and wire mesh to Tops Construction Co., 945 King St. W. Estimated cost $150,000.

Ont., Smith Falls—Frost & Wood Mfg. Co., plans the construction of a 1 story factory for the manufacture of combines. Estimated cost $100,000. Private plans.